Read **Radiation From Bikini**

CHEMISTRY

UNIVERSITY
AUG 23 1946
LIBRARY

Radiation from Bikini 1
Able 2
Baker 4
Journey to Bikini 8
Iron From Manganese 15
DDT's New Competitor 16
Technical Patents Listed 17

Chemical Magic:
Pour Water from Empty Glass 21

Camp Detrick Discoveries 23
Scent from the Isle of Cyprus 25
Back Cover: Persian Attar
Soilless Gardens in Japan 34
For the Home Lab:
Manufacture of Sulfuric Acid 35

Chem Quiz:
A Chemical Word Square 37

Atomic Energy Applications 38
Aralen Combats Malaria 40
War on Weeds 41
Now You Take Magnesium 45

Editorial:
The Year One ..... Inside Front Cover

AUGUST 1946

25¢

Nineteenth Year

★ *A SCIENCE SERVICE PUBLICATION* ★

The Year One

➤ THE FIRST YEAR of the Atomic Age has passed. The repercussions of its dawning have been nearly as violent as the bomb itself. Its implications for the future may be even more explosive. Confused politicians seeking escape from looming disaster turn this way and that down old pathways that are known to lead only to more disaster.

It is significant that in the midst of this panic the only people with a constructive viewpoint are the scientists responsible for this new and terrible force, and that their plan is designed for peace and safety.

The bankruptcy of the military mind is shown by that quaintest of comparisons: "The atomic bomb is no more destructive than 20 tons of block busters." Who besides the military finds comfort in the thought of being hit by 20 tons of anything, explosive or not?

There have been several Ages of Man. The most primitive that we now can trace is the Hunting Age. It was characterized by fear, stealth and suspicion. Its chief aim was the development of more powerful weapons. Reversion to such a culture can be all too easy. The last time it happened civilization took a thousand years to recover.

As man learns better ways of cooperation, he is able to progress to higher levels of community living—farming, trading, manufacturing. He has already learned to apply power to these efforts—animal, steam and electric power—which allows more people to live longer, better and more happily. Atomic power can continue this progress. It is the privilege of the well-disposed now to get international confidence going once more toward this goal—and soon.

CHEMISTRY

Vol. 19, No. 12 Formerly The Chemistry Leaflet August 1946

Including The Science Leaflet

Published monthly by Science Service, Inc., the institution for the popularization of science. Publication Office: 119 South Frazier St., State College, Pa. Entered as second-class matter at the Post Office, State College, Pa., under Act of Congress of March 3, 1879. Address communications to Editorial and Subscription Office: 1719 N St. N.W., Washington 6, D.C.

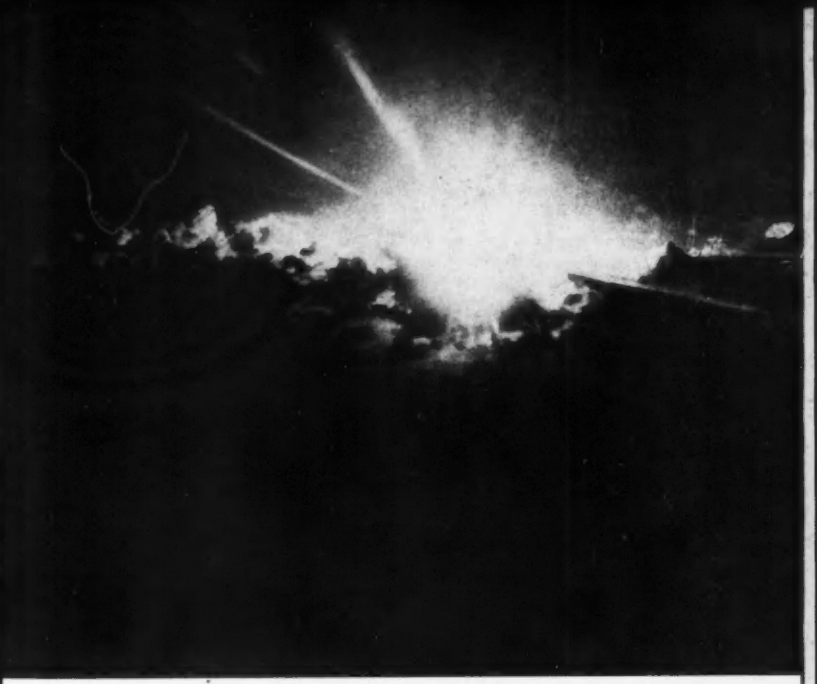
25c a Copy; $2.50 a Year. Two-Year Subscription $4; Your Own and a Gift Subscription $4. Quantity Subscriptions, 10 or more copies to same address: $1.70 a Year, $1 for any seven months, 15c each Copy each Month. No charge for Foreign or Canadian Postage.

Editors: WATSON DAVIS and HELEN MILES DAVIS

Consulting Editor: PAULINE BEERY MACK (Editor 1927-1944)

Copyright 1946 by Science Service, Inc. All rights reserved. Science Service issues press service for newspapers and magazines, publishes Science News Letter (weekly), issues THINGS of Science (monthly) and administers Science Clubs of America.

Science Service is the educational and scientific institution organized in 1921 as a non-profit corporation with trustees nominated by the National Academy of Sciences, the National Research Council, the American Association for the Advancement of Science, the E. W. Scripps Estate and the Journalistic Profession.



RADIATION *from the atomic explosion shone like a bigger sunrise over Bikini atol as the bomb went off. This and the following picture are from a series taken by Joint Army-Navy Task Force One, showing characteristic stages in the appearance of the atomic explosion products.*

Radiation From Bikini

SELDOM are chemical experiments performed on such a large scale and with such acclaim as the two trasmutations of plutonium with the accompanying conversion of mass into energy that were made on July 1 and 25 at Bikini Atoll, the Marshalls, in the Pacific.

Many kinds of radiations resulted from these powerful atomic bomb explosions. Most immediate were the visible radiations pictured in an official photograph reproduced on this page. It was as though a miniature sun appeared and disappeared in a flash. Just what the radiation temperature is in an atomic bomb we have not yet been allowed to know. We do know that astronomers look upon it with some interest and envy.

The heat is immense. One scientist reported that the explosion felt like a

CHEMISTRY HALL LIBRARY

blush upon his cheek at a distance of 19 miles. In Hiroshima and Nagasaki many had flash burns from their own special atomic bombs that brought them instant or slightly lingering death.

There was a kind of radiation new to military and naval strategy and unattached to TNT, PETN, RDX, and other such lesser explosives. The atomic bomb is a giant X-ray machine and a powerful creator of neutrons, which means that radiological effect is one of its most important consequences. Great concentrations of gamma rays and immense bombardments of neutrons are let loose, plunging through thick steel plates of battleship armor, killing eventually after some days and weeks of delay, the living creatures, such as mice and (in atomic war) sailors, who may be within radiological range of the bomb's explosion.

Sodium and chlorine in sea water, carbon in the marine ooze, and a host of other chemicals in the immediate vicinity of the bomb become radioactive and the whole explosion area becomes "hot" and dangerous. These radiate at a great rate, and the very air and the water may carry danger and perhaps death.

There are other radiations from Bikini. Solemn military and naval pronouncements, for instance. Reports from formal scientific boards. Discussions all over the globe pro-Bikini and anti-Bikini, politically, scientifically and psychologically. Radiations to UNO and the U. S. Congress.

And then the thousands upon thousands of words in press reports from one of the largest galleries of correspondents to witness a scientific event.

CHEMISTRY had its upon-the-atom representatives covering Operation Crossroads. For Test Able, the bomb dropped from the air in the Hiroshima-Nagasaki tradition, the Science Service Crossroads correspondent was Dr. Frank Thone. Test Baker set off under water on July 25 was reported by Daniel Wilkes, a Pacific Coast correspondent for Science Service who has followed intensively the progress in the University of California radiation laboratories where the cylclotron gave birth to plutonium. Chemistry today affects much more than the laboratory, industry and the primary radius of an atomic bomb. For this reason, CHEMISTRY presents a Bikini diary wirelessed and airmailed from one of the atomic frontiers in our disturbed world. Words are blandied about by Science Service's Crossroads Correspondents. Photographs by Joint Army Task Force Number One.

ABLE

by DR. FRANK THONE

➤ A GLOW almost as bright as the face of the sun and very much larger. Then a yellowish-pink cloud rising fast from the sea. Then around it a wall of what appeared to be spray thrown very high. That was the beginning of the explosion of the first test atomic bomb over Bikini atoll, the moment for which the world has been waiting all summer.

The wall of spray subsided, but the glowing cloud climbed higher and higher. In a couple of minutes it had

▶ THE SLOW, *rolling cloud of debris which we have learned to recognize as characteristic of the later stage of the atomic bomb explosion may be seen near the center of this photograph. This picture was taken from a plane speeding away from the site of destruction.*

reached the flat base of a cumulus cloud that stood between it and us, who were watching from all possible points of vantage on the Appalachian. It kept on climbing, thrusting out tight cauliflower heads all the time, showing how the enormous energy was still boiling within it.

At the end of nine minutes it was 24,000 feet and half that in diameter. At 15 minutes it had broken in half, with the upper part drifting away. A little longer, and the parts were lost in the rolling cumulus, that covered that part of the sky.

Awesome prophecies all failed of fulfillment. There was no tidal wave, no earthquake shock, no "setting the sea afire." The sound, when it reached us at our distance of 18 miles, was no louder than a battleship's broadside at that range.

For scarehead folks, a very "tame" show.

The explosion of an atomic bomb has been likened to what goes on in the interior of the sun. It has also been suggested that the end of the world or at least of the solar system might have been like such an explosion.

It strikes me that what we have just seen might be taken as a miniature picture of the beginning of the universe. Many scientists, especially astronomers, take seriously the theory of the expanding universe, because all the great star masses or galaxies appear to be rushing away from each other. It might well be called the exploding universe for the calculated speeds are the order of the leap of the first flame-jet from detonating TNT.

Especially significant contributions to this view have been made by Dr. Harlow Shapley, director of the Harvard College Observatory and president of Science Service. An American-educated, Belgian scientist, Canon Georges Lemaitre, not long ago completed the picture by running the figures back to a time before the universe started to expand. He calculated that time was not much more than two billion years ago. The matter and energy now distributed throughout the universe were all jammed into one super-atom.

That atom exploded, and the universe began to be. The explosion is still going on, flinging enormous star masses out to frontiers hundreds of millions of light-years from that primordial center of creation.

The tremendous explosions of matter that cause the sun and all the stars to give forth light and heat are mere secondary cracklings of this unimaginable immense cosmic detonation. Once in a while, a star will burst forth with many times its normal explosive power, and we have a nova.

Part of the explosive potential that was packed into what eventually became the element uranium was what we witnessed today, from a safe distance, lest we be temporarily blinded by the flash. It was just a minor spark, unnoticeable on a cosmic scale, in the long story of an exploding universe.

BAKER

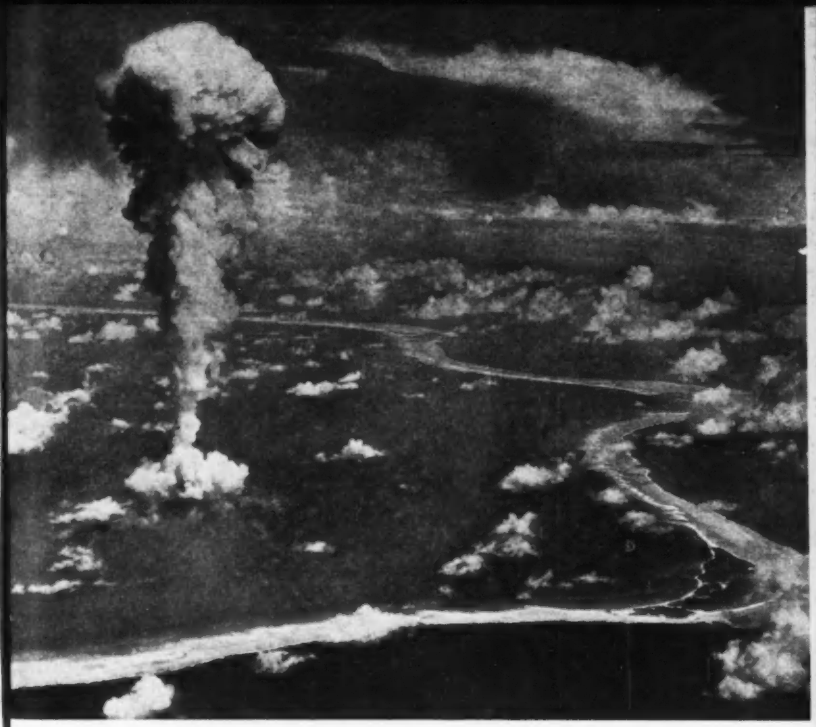
by DANIEL WILKES

➤ THE GATES of hell yawned briefly before me across a peaceful stretch of the Pacific and then clanged shut with the fury of a thousand monsters and steaming radioactive water.

The fifth atomic bomb had been born and died—breaking surface like a Beowulf sea monster lashing in primordial agony at the sea and the test ships spaced neatly in the lagoon.

That was my first reaction to the underwater explosion of an atomic bomb viewed through binoculars. A column of water in brown colors hurtled into the air at a speed of 2,000 feet per second, followed by a breaking at the top. At the bottom were much larger, great, billowing, white and beige clouds, which spread quickly at first and then more slowly, hugging the sea surface.

In a few minutes the central target area was obscured for perhaps a diameter of two miles.



➤ ATOMIC CLOUD *rising from Bikini Lagoon shows for the first time the location of the tests of the atomic bombs. The photograph was made by the Joint Army Navy Task Force One.*

The top cloud broke first into a dirty brown color, spreading into a luminous white mass which was soon lost in nature's clouds.

The underwater blast shook our ship slightly soon after the column appeared, followed about a minute later by blast and distant boom which rocked the vessel as though it had hit a high wave. The cloud a thousand feet high and dirty at the bottom cleared only slowly.

Within an hour the target area was cleared, but nearly two hours later the surface cloud, diffused but still visible, moved toward the horizon as a sickly fog hugging the sea.

While the Arkansas had gone down, the Saratoga, badly damaged, and other ships were listing, it was still hard even two hours later to hold onto one's first reaction. Normalcy had returned to our ship, and the scene was much the same as it was before the blast.

There was a water-cooled, cushion-

ed fire of a hundred million degrees at center of the explosion. There were no dead people in the lagoon; none were dying which deadly gamma radiation would have rendered us powerless to rescue. There were no raging fires which, like heathen suns, lighted Nagasaki and Hiroshima.

In a different magnitude, seeing the explosion of the atomic bomb today was like watching from the safe distance of the earth a super nova explode in some great island universe a hundred billion miles away.

To many watching men, it was an impersonal spectacle of only transitory interest.

But such detached attitude toward the atomic bomb is unreal for it is a personal thing to every man. It can be aimed at him.

To appreciate the spectacle in the lagoon, the observer must don goggles of retrospect and project himself over 10 miles of peaceful Pacific into a holocaust where concussion, heat and deadly radiations are making a small area of earth as untenable as the surface of a nova in the distant sky. He must know these things which are unseen in a column of smoke and unheard in a distant boom.

When, through these goggles, he gains capacity to think in terms of a rain of such novae on his city, then he becomes quite sure that only by making the bomb a personal thing can its influence over the earth be interpreted.

Strategy

➤ THE STORY of the devastation we can now see in the lagoon here began more than two years ago in early 1944, before the first atomic bomb exploded.

These tests are based, in part, on tactics considered for use against Japanese naval power, Rear Adm. W. S. Parsons, deputy task force commander for technical direction, revealed to me as we surveyed the damage from the underwater blast.

Late in 1943 and early in 1944 we did not own bases from which we could attack Japan, Adm. Parsons explained, adding that Truk was a primary target.

For a few months in 1944 until Truk ceased to be a threat, some consideration was given the atomic bomb, which was still in the development stage, for use against the Japanese navy.

After we went duck shooting through the Truk area in 1944, the Japanese Navy ceased to be a threat, and we stopped considering the bomb for use against it, Adm. Parsons disclosed.

Maj. Gen. Leslie R. Groves of the Manhattan District and others were in on the calculations at that time, he reported.

Our memory of the earlier considerations served as a background when we began laying out these tests, the deputy task force commander said, adding:

I must say that our ideas in 1943 and 1944 on naval atomic warfare were not fully developed.

These tests at Bikini represent a much greater crystallization of thought on the matter, Adm. Parsons declared.

He pointed out that the job of developing the atomic bomb went into high gear late in 1942. At that time,

and for some time after, the United States was fighting a defensive war. Therefore, he said, it was necessary to give thought to using it in a manner which would at that time most benefit American tactics — against Japanese naval power.

Once that threat was eliminated, the primary target became Japanese cities, and all effort was given to developing tactics for such targets as Hiroshima and Nagasaki.

Adm. Parsons was in charge of Naval activities at the atomic bomb factory at Los Alamos, N. Mex., where the weapon was developed.

If the Japanese Navy had survived other weapons, these tests at Bikini to see what an atomic bomb can do against Navy ships might not now be necessary.

Scientists are getting their first really good chance to get full information about what atom bombs can do as a result of the two tests at Bikini, Rear Adm. W. S. Parsons pointed out at a press conference.

The test at Alamagordo, in March of 1945, could not be called a test in the full scientific sense, because it had to be conducted under wartime pressure, which permitted no time for obtaining full instrumental and photographic data.

Lethal Mist

▶ THE BREATH OF DEATH, even more than the shattering of ships, was the most awesome thing about the second atom-bomb's subsurface burst at Bikini.

It is already being suggested that newer capital ships might have survived the underwater shock that sank the old Saratoga and the older Arkansas, but if they did remain afloat they would surely be manned only by corpses.

That clinging, persistent, lethal fog of radioactive water droplets and fission byproducts that the bomb spewed into the air over the whole target area on Baker Day, drenching every ship in the array, could hardly have left anyone alive on board when it finally did move slowly away, like a legendary monster reluctantly leaving its prey.

Anybody on deck of a ship drenched with this deadly fog would be a "goner," Vice-Adm. W. H. P. Blandy, commander of Joint Task Force One, commented. And the ventilating systems of all present-type ships would most probably spread it all through their interior spaces before the blowers could be shut down.

Even after the cloud itself had slowly moved off, a large part of Bikini lagoon remained too "hot" with radioactivity to permit anything but the quickest dashes into the contaminated area, under carefully guarded conditions. A few of our newspaper group went in with Admiral Blandy, staying only a half-hour. Yet when the group came out, instrumental tests showed that each man had absorbed two-tenths of a Roentgen unit, which is twice the allowed tolerance for 24 hours.

One thing was noted, however, while the party was inside: whereas few fish if any were killed by the first blast, this time there are plenty of them. Probably they succumbed to the same shock wave that sank the ships, though lethal radiological effects may help account for them.

Travel Notes On the Trip to Operation Crossroads

Journey to Bikini

by Dr. Frank Thone

June 8

➤ This first leg of the road to the Crossroads, where the atom-bomb tests are to be made early in July, is like any other railroad trip—with a few interesting exceptions.

We are a trainload of assorted people, all going to the same remote spot on the other side of the world, all to see the same awesome event, all to do a diversity of things about it. They loaded us aboard at the Washington Union Station at 10:30 Saturday night, and we started over the thousand-times-travelled road to Chicago, to change roads in the yards there and head right on west without even seeing the downtown station.

But there are a few differences between us and the usual westbound train. For one thing, there isn't a woman aboard. Crossroads Operation is to be strictly a stag affair. But we do have a variety. Newspapermen predominate, at least among the civilians; but there are radiomen too, and cameramen both movie and still. One car is full of Army and Navy officers, and there are other officers scattered throughout the train—we'll not lack for official chaperons, evidently.

Although we're an all-male train we are not all-American. Among the foreign observers I've spotted so far are a pair of Egyptians and a couple of Russians. . . . Which makes me wish it were possible to bring along topside diplomats and foreign ministers instead of just accredited observers. The impression might be effective if it were first-hand.

One queer thing, in retrospect: A few days ago I stopped at the city ticket office in Washington, to check up on my reservation. That was OK; but when I asked the man when the train left, he hesitated, telephoned to somebody upstairs, then told me it was a military secret. I had to learn my train time by calling up the Navy Department!

June 10

➤ We are now well into the West, we pilgrims to the Crossroads where the world's most terrific experiments in military science, physics and biology are to be staged. The flat landscape slipping endlessly by the train windows tells that we are crossing the plains: few trees, wider pastures, more wheat than corn in sight. It is a drier, sunnier land than the eastern prairies which we crossed yesterday.

June 12

➤ As we passed under the Golden Gate Bridge I stood on deck in a stiff breeze, and looked back at the sunny hillside campus of the University of California where plutonium, the stuff of the atom bomb, was born. In the midst of the neo-Grecian structure of this seat of higher learning, towers the significant, white pointed spire of

the University's Campanile, which can be seen far at sea.

At the base of the spire is the 60-inch cyclotron of Prof. Ernest O. Lawrence, Nobel Prize winner and inventor of that machine, housed in a squat white building. In this atom-smasher were produced neptunium and plutonium and the new trans-uranic elements, 95 and 96. Behind the spire on a sun-browned hill sits a huge, red-roofed building. It almost looks as though it is resting on the spire. In this and the adjacent building, housing the 184-inch cyclotron and the synchrotron, machines many times more powerful than the 60-inch plutonium producer, lies the frontier of atomic research.

I stood on that hill yesterday and looked out over the campus and the bay and Golden Gate. Almost literally it dominates the Pacific, and the tests which I shall soon witness of products of the hill's laboratories against naval power. In the laboratories on the hillside are a group of the world's leading nuclear scientists, all too busy pushing back frontiers of research to spend time required to travel the great distance to Bikini.

Prof. Lawrence, blond and still boyish, is leading a group of even younger men, including Profs. Edwin M. McMillan and Luis Alvarez, in devising new methods of increasing the power of atom-smashers. Prof. J. Robert Oppenheimer, sometimes known as the "king of the atomic bomb" and one of the greatest theoretical nuclear physicists, is trying to calculate forces involved in atom smashing in the 200 to 400-million-electron volt energy ranges of which the new machines will be capable.

Dr. Glenn Seaborg, co-discoverer or plutonium and elements 95 and 96, and leader of the atom bomb project's plutonium separation process, is in charge of a group of brilliant young chemists who are searching for new elements and for improvement of "tracer" tools of atomic research in physical sciences and in biology and medicine.

As the sunny hill fades behind the Golden Gate, I cannot help but think that I am leaving the future behind. Even as I watch the Bikini explosions I know I shall not be able to erase from my mind the picture of the white spire pointing insistently at the red-roofed building on the hill.

June 14

➤ As OUR SHIP ploughs through the waters of the Pacific toward Pearl Harbor on the first leg of the trip to Bikini Atoll for the explosion of atomic bombs against ships of the Navy, I have been letting my imagination run ahead of the tests at Bikini—years ahead.

What is going to happen to the ships after they are sent to the bottom by the two bomb blasts, one in the air above them, one in the water a little below?

Lie there and rust in the still salt water, until nothing is left but heaps of iron oxide—that might be the first idea to strike one.

But that notion reckons with the sea containing nothing but dead salt water. Noting could be farther from fact. The sea is a living thing, especially the parts of it that are shallow and warm, as in the lagoon of an atoll.

All manner of living creatures will

swarm aboard the sunken ships, as soon as quiet is restored in the lagoon and the deadly radioactivity has diminished to a life-tolerable level. First, marine bacteria will form films on the steel plates; these films will give foothold to later comers. Soon the decks, upper works, masts, funnels, everything will carry a mixed population of barnacles, sponges, sea anemones, mollusks and other "rooted" animals. Brilliant fishes will swim in and out of the observation towers and the ack-ack positions. Crabs will sidle across the sloping decks, octopuses will lurk in the gun-ports.

But this will not be forever. The coral will come. Coral is not the first thing to grow on newly available sites in the warm seas, but it is almost alwas the last. It will appear among the myriad other animal forms, gradually spreading and growing higher and thicker, until the entire wreck is encrusted. Nothing about the sunken ships "but undergoes a slow sea-change into something rich and strange."

After centuries, nothing will be discoverable about the once proud vessels of war but masses of coral. Oceanographers of that day may wonder a little over their somewhat atypical shape.

June 22

➤ ONLY A CLUSTER of clouds hovering on the horizon shows where the high moutains of Hawaii stand. Farther behind with every turn of the propellers lies Honolulu, the hospitals, after 48 crowded hours of impressions vividly colorful but piled one upon the other so fast that they become a bright blur.

We are again heading west and south toward Kwajalein—after that, Bikini and the bombs. What pictures emerge from the bright blur? Cliff-sided mountains, tapestried with vegetation, the bright-flowered shrubs and trees, exotic in appearance and even more exotic in names. But they have high usefulness as well as great beauty for this living tapestry catches and holds the water. That is the basis of Hawaii's great agricultural wealth.

Irrigation ditches lead the water to the wide fields of sugarcane and pineapples on the coastal plain. The canefields are planted on contour lines in accordance with the true gospel of soil conservation. The cane planters also lift their eyes to the hills whence cometh their help. They send men on foot with seedlings, men in planes with seeds to speed the forestation of slopes where the forest is not yet adequately thick.

On the north beaches of Oahu island there are still abundant traces of the great sea wave that took its toll in lives and property in April, wrecked cabins and scattered possessions of the luckless folk who lived there, uprooted shrubs and pushed-over trees. Yet so rapid are the processes of natural healing in these islands that by another summer it will be difficult to find real scars of this disaster.

One of the scientists going to Bikini to observe the effects of the atomic bomb explosion has been charged with a unique biological errand. Dr. Carl R. Dunbar, director of the Peabody Museum of Natural History, Cambridge, Mass., who is with the National Academy of Sciences party was

asked by Dr. Dillion Ripley, orinthologist on his staff, to kill and bring home pickled in a botttle of alcohol one Bikini rail.

Rails are smallish, stilt-legged wading birds related to snipes and sandpipers that mince daintily among the tide pools picking up small shrimps and similar tidbits. Bikini's one species of rails is found nowhere else in the world.

Dr. Ripley fears that after the atomic bomb bursts scheduled for next month there will be no more Bikini rails.

If they are not killed outright by concussion, their startled flight may carry them upward into the cloud of deadly radioactive materials. If they escape this, they may be poisoned by the food they pick out of the plutonium-polluted water. Or the second explosion at or below the surface of the lagoon may overwhelm them and their nests together with the sweeping wave it is expected to throw up.

If the Bikini rail becomes an extinct species in a fraction of a second some July morning, it will be a good thing to have another museum specimen so that future scientists can tell what it looked like.

June 24

➤ THE ATOM BOMB'S effect on Bikini's ecology will have a blurred record because DDT was sprayed wholesale over the atoll islands before Seabee forces went to work there weeks ago. This was done to abate the plague of flies that wrecked comfort and threatended health. Biologists making the "before-B day" survey objected but Navy authorities decided in favor of the Seabees.

DDT, as is well known, plays no favorites. It kills flies, mosquitoes and other pests, but also knocks down butterflies, moths, beetles, wild bees and almost all other insects that live above ground. Unable to capture native insects, entomologists will have to turn in an incomplete record. It is wholly possible that some of the victims of this necessary massacre are species unknown to science. Now they never can be known.

But this is only the beginning of the story. Services of some of these insects are needed by some species of plants to make the fertilizing transfer of pollen. If these species die out after the bombings or are sharply reduced in abundance, the scientists cannot be sure when they make their "after-B day" survey whether the change is due to the bomb's radioactive spraying or to the DDT spraying.

There may be effects on animal life too. Some birds and almost all lizards depend mainly on insects for food. Recent experiments indicate that DDT-poisoned insects do not kill birds and fishes that eat them but if the insects are killed off where will the birds find food?

Thus this one monkey-wrench, thrown into this atoll's ecology, sprinkles question marks all over the biological record.

June 25

➤ CANCER RESEARCH may get some help from the atomic bomb explosions at Bikini.

Some of the 400 rats and 120 mice that will be exposed are of hereditary types known to be susceptible to cancer. Those that survive will be watched closely, and their cancer records

compared with those of similar animals that have not experienced atomic bombing.

Some of the goats aboard the target vessels will have their hair clipped to simulate human haircuts. Others will wear flash-proof clothing, and still others will be under flash screens

Blood counts and examinations for blast effects will be made as promptly as possible after the first explosion to see what has happened to them.

June 27

➤ THERE HAS BEEN a good deal of discussion about the possibility of sudden new evolutionary changes in the plant life of Bikini, that may follow the atomic bomb explosions. What plants are on Bikini, on which such strange wonders may be wrought?

Little is known of the atoll's plant life. The Japs had collected information, but that's still inaccessible. During the past few weeks, American botanists have worked over the island, but they haven't brought their data out yet.

The collection of plants from other atolls in the Marshalls at the Bernice P. Bishop Museum in Honolulu reveals 76 species of plants in all, as compared with five to ten times that many that can be found on an equal area in almost any state in our country.

Atoll floras, it appears, are very meagre at that. Many of the plants now growing wild must have been brought in by migrating natives: food plants like the ubiquitous coconut, and the pandanus whose tough but tasty food they like, and sour-fruited citrus tree; ornamentals like hibiscus, plumeria and three kinds of morning glory.

There are a few familiar weeds such as purslane and pigweed, which may have been brought in with the seeds of such conventional vegetables as beets, cucumbers, lettuce, onions and tomatoes, found in the natives' abandoned gardens.

If the atomic bomb radiations are to speed up evolution by centuries in a split second, they'll have to work their miracles on rather scanty raw material.

June 28

➤ AN ISLAND in the Dry Tortugas off the tip of Florida might give a fairly good idea of what the vegetation of a Pacific atoll such as Bikini looks like. It's all very hard on the glamorous visions made in Hollywood of lush glens full of tree-ferns, orchids and shy, brown-skinned maidens in sarongs.

That belongs, if anywhere, on larger islands like Samoa, where there is more soil, and there are mountains to catch the clouds and make rain. Life for tree and human being alike is anything but easy in the low-lying, thin-soiled, scant-moistured Micronesian Isles where we are.

Col. Edwin L. Bryan, Jr., an ecologist who knows the atolls of the Marshall Islands and collected the plant collection I examined at the Bernice P. Bishop Museum in Honolulu, told me that the native vegetation of all the atolls follows a uniform, rather monotonous pattern.

On the windward side of any island or islet there will be an impenetrable thicket of tough-stemmed, hard-leaved bushes and trees forming a kind of

natural barrier against the almost incessant wind. In the lee of this, the plant community opens out a bit forming what he calls "dry forest." The trees and shrubs have the same hard, harsh leaves, often waxy or hairy, that we see in our own southwest—or on our own beach dunes.

Corals get the credit for forming the reefs of Bikini and similar atolls, but seaweeds really do the work, Dr. William R. Taylor, University of Michigan botanist at Operation Crossroads, tells me. Dr. Taylor has been making a study of Bikini plant life, especially the marine plants, as part of the general biological survey being conducted here under the direction of the U. S. Fish and Wildlife Service.

Non-botanists might easily mistake the reef-forming seaweeds for corals for they are mostly bright red in color, and stiff with limestone. They make up about nine-tenths of the mass of the reef, corals only one-tenth. Dr. Taylor stated that he has found well over a hundred species of these limy corals around Bikini atoll and added that it is one of the richest floras of this kind he has ever seen in one spot.

June 30

➤ THE ATOM BOMB'S whole story, from Alamogordo to Bikini, is framed and backgrounded in ecology, the science that examines the effects of environment on all living organisms—including man; in this case, especially including man. To begin with, the idea of any weapon so monstrous as an atom bomb would never have occurred to either scientists or fighting men if there had not been targets worthy of its immense power—and equally immense cost. That means, primarily, cities, and the massed products of city industry such as the doomed fleet anchored in the lagoon. The atom bomb is too massive a weapon to be used against such minor targets as a primitive tribe on the warpath, or a single capital ship, or a dispersed enemy division. And such massing of people, buildings, and equipment as constitute a logical atom-bomb target depend on a complex of ecological factors: good soil and favorable climate for food production, natural traffic lines such as rivers, good harbors on deep water.

Ecological factors were potently active in the development of this weapon capable of destroying a whole city at one blast. Enormous quantities of electric power were needed to separate U-235 from U-238, and to convert the latter into the new chemical element plutonium, as well as vast volumes of water for cooling purposes. Natural sites for these processes were in the places where rivers collected the power-yielding streams emerging from timbered hills. Dam systems, originally intended to develop the ecological resources of the land for peacetime purposes, existed in the Tennessee Valley, the Pacific Northwest. So the cities that would in time have grown there naturally were suddenly created under the pressure of war.

Selection of the test site in the New Mexico desert was even more obviously a result of ecological consideration than the location of the bomb's making-places. What was needed was plenty of room with no people in it, or any concentration of valuable things. Lack of rain took care of that matter in the Southwest; the un-

friendly ecology of the region, excluding all men except a handful of wandering shepherds and a few stray Indians, easily removed, was just what the Army and the scientists wanted.

This combination of ideal sites for production of fissionable material and an ideal site for the first bomb test was largely responsible for the selection of the United States as the country where atomic bombs should be developed and produced. War-crowded Britain might have been able to produce the bomb, but would have been hard put to find enough empty space for a safely conducted test.

Both the target cities in Japan were where they were because of ecological factors. Hiroshima was built on a river delta, which meant easy transportation of supplies from up the valley to the crowded urban populace at its lower end. Nagasaki grew up around a fine, deep-water harbor, on a narrow shelf of land crowded between the hills and the sea. In its case, ecology played the role of a tragic Fate.

Finally, when a safe site was needed for this test of the bomb against warships, ecology took a decisive hand in the game. What was needed was an oceanic equivalent of the desert. A lonely island was the likeliest place; but most of the world's lonely islands have no sheltering harbors where the target ships could be anchored, no anchorages shallow enough to permit divers to examine sunken ships after the bomb had done its work.

Atolls, of which the Pacific has an abundance, seemed the logical answer. And atolls are the product of marine ecology: the habit of corals to build always outward, toward the water that brings them food and dissolved oxygen. This ecological habit has brought into being the scores of magnificent harbors that lack cities on their shores only because they have no continental resources to feed them.

Even what land there is in an atoll is almost desert in its ecology. Soil is thin and infertile; though frequent rains fall their water is rapidly removed by rapid evaporation. That means a sparse human population, poor in this world's goods, and ready to be picked up and moved to another place if a better life there were in prospect.

So ecology brought us to Bikini.

New-Found Mold Chemical Stops TB Germs

➤ DISCOVERY OF a new anti-germ chemical that stops human tuberculosis bacilli in test-tube experiments is announced by Dr. Isadore E. Gerber and Milton Gross, of the Hudson County Tuberculosis Hospital, New Jersey.

Whether the new substance will prove effective in treating tuberculosis is not stated in the scientific report, which covers only preliminary study of the substance. Penicillin, most famous of the mold anti-germ chemicals, has no effect on tuberculosis germs.

The mold from which the new substance was extracted has not yet been completely identified but is one of a group of *Aspergillaceae*, of which family *Penicillium* is also a member.

Radioactive Iron Reveals Information on Body Processes

Fe from Mn for Tracer

➤ TRACER EXPERIMENTS with radioactive iron show that the bone marrow manufactures the red blood pigment, hemoglobin, much more rapidly than had been supposed and that the liver acts as a storehouse for iron.

These new findings have been reported by two University of California researchers, Dr. D. Harold Copp, instructor in physiology, and Dr. David M. Greenberg, professor of biochemistry, who used a superior radioactive isotope of iron for the first time in tracer work.

They found that within three hours some of the radioactive iron appeared in the red blood cells, an amazingly rapid absorption, and that within 24 hours one-third to one-half of all the absorbed radioactive iron had been transferred to these cells.

When there is no deficiency, iron is stored in the liver, and is transferred to the bone marrow for use in the production of hemoglobin when iron is removed from the diet. Thus the stored iron postpones the appearance of deficiency symptoms such as anemia.

Drs. Copp and Greenberg found that there is no liver storage when hemoglobin manufacture is stimulated by iron deficiency, by the action of small amounts of copper or cobalt, or following severe blood loss. The metal, in these cases, is being used rapidly by the bone marrow.

While the experiments were performed with rats, the findings are significant for man as well, since the metabolism of this animal is much like that of the human species.

The experiments were performed with iron 55, a radium-like member of the iron family produced by bombardment of manganese in the cyclotron. This isotope of iron was identified and separated at the University of California, the work being done by Prof. Glenn T. Seaborg, co-discoverer of plutonium, and by Dr. Martin Kamen, now at Washington University, St. Louis.

Iron 55 can be produced in a very pure form, though in minute quantities too small for human research. Because of its purity it is superior for biological research to iron 59, the isotope previously used for "tracer" work. Iron 59 is diluted by a large percentage of non-radioactive iron which makes it necessary to give doses up to 1000 times those used in work with iron 55.

In their experiments the researchers fed anemic and normal rats 15 microgram doses—hardly more than enough to cover a pin point—of iron 55. The animals were then sacrificed at intervals, and the radioactivity in the various organs was counted by a Geiger counter.

The iron from the sacrificed animals was electroplated to make counting easier, and a special Geiger counter, of extreme sensitivity, was devised to catch the very weak radiations of iron 55.

DDT's New Competitor

➤ DDT HAS a new competitor in the insect-killing business, claimed to be even deadlier to some species. It is a compound described as a chlorinated hydrocarbon, to which the trade name Velsicol 1068 has been given. The number 1068 affords a hint as to its composition: it contains 10 atoms of carbon, six of hydrogen and eight of chlorine to the molecule, giving it the empirical formula $C_{10}H_6Cl_8$. This of course gives no clue to the actual structure of the molecule, for the same assortment of atoms could be arranged in many different ways.

The new insecticide was compounded in the laboratories of the Velsicol Corporation, which will manufacture and market it as an ingredient for sprays, insecticidal paints, etc. Laboratory and field tests on a limited number of insect species have been conducted by three entomologists, Prof. C. W. Kearns and Prof. Lester Ingle of the University of Illinois, and Robert L. Metcalf of the Tennessee Valley Authority.

Prof. Kearns states that the new compound has been found from three to four times as toxic to houseflies as DDT, twice as toxic to potato beetle larvae and to pea and spiraea aphids. It was about equal to DDT and the British insecticide known as Gammexane in its deadly effects on the "wigglers" of the most common of the malaria-carrying mosquitoes, Anopheles quadrimaculatus.

Precisely measured dosages of 1068 and DDT applied externally to adult American cockroaches revealed 1068 to be approximately three times more toxic than DDT to this particular insect, Prof. Kearns continues. Measured quantities fed to adult grasshoppers indicated that 1068 is between five and 10 times more deadly, weight for weight, than DDT; also that it is from two to four times more poisonous to grasshoppers than Gammexane.

Volatility tests showed that 1068 is intermediate between Gammexane and DDT in its evaporation rate, so that it can be expected to last longer than the British poison but not so long as DDT when used in paints or as a residual spray.

Thus far, Prof. Kearns adds, little information has been obtained as to the effect of 1068 on plants and animals other than insects.

Fungi Get Used to Poisons

➤ THE FUNGUS that causes the disfiguring and damaging disease, corn smut, can get used to poisons if it has a chance to sample them long enough, it was demonstrated in experiments reported by Prof. E. C. Stakman and associates, of the University of Minnesota. Strains of the fungus grown in the laboratory stepped up their tolerance for sodium arsenite to nearly three times what it was at the outset. This increasing tolerance for poison helps to explain why sprays and other treatments eventually lose their efficacy and have to be made stronger to produce desired results.

Technical Patents Listed

➤ THE PRICE *charged by the Patent office for copies of patents has been raised from 10 cents to 25 cents each. Remittance should be by coin, money order or Patent Office Coupon to the U. S. Commissioner of Patents, Washington 25, D. C. Patents must be ordered by number.*

➤ A CONTINUOUS, high-temperature process for separating aluminum from its more abundant ores, such as spinel and alumina or clay, is offered by Daniel Gardner of New York, for patent 2,400,000. As the ore is moved through the long furnace, it is first converted into aluminum carbide. Then the carbide is heated above 1,800 degrees Centigrade, the boiling point for the element aluminum, and the metal condensed out of the vapor. The inventor claims that aluminum in a state of almost complete chemical purity, as high as 99.998%, can be obtained by his process.

Ammonium Nitrate

➤ AMMONIUM NITRATE, one of the most valuable of fertilizer salts, frequently makes trouble by taking up moisture from the air and becoming so hard and caked that fertilizer spreaders cannot handle it. A treatment to overcome this tendency is the subject of patent 2,399,987, issued to Cornell H. Cordie and Dr. Robert W. Lawrence of Wilmington, Del.

Ammonium nitrate, in a granulated condition, is very thinly coated with a mixture of rosin, paraffin and petroleum jelly, and then mixed with a small percentage of kieselguhr or other dry, dusty substance. The inventors state that after this treatment the salt remains granular and free-flowing indefinitely.

Improved Stove

➤ FOR USE where wood fuel is abundant, a Swedish inventor, Birger Johansson of Nykoping, has devised a stove or furnace in which the combustion gases are forced through a mass of water before they are permitted to escape up the chimney. The water extracts practically all the heat, including the heat of vaporization of the water originally contained in the wood, which is considerable. It also takes out all soot and fly ash. Patent 2,399,871 has been granted on this invention.

Hot or Cold Cars

➤ AN INVENTION that permits conversion of refrigerator cars into heated carriers for perishable goods in winter is covered by patent 2,399,950, which the inventor, C. K. Steins of Merion, Pa., has assigned to the Pennsylvania Railroad Company. Removable heaters, burning charcoal, oil or other fuel, are placed in the ice bunkers.

Penicillin Recovery

➤ A METHOD for getting penicillin out of the culture-liquor on which the mold was grown is the subject of patent 2,399,840, granted to J. L. Wachtel, of the Northern Regional Research Laboratory at Peoria, Ill., and assigned royalty-free to the U. S. Department of Agriculture. Powdered

activated carbon is added to the liquor and thoroughly shaken, then the liquid filtered off and ethyl acetate, amyl acetate or other organic solvent added to loosen the carbon's grip on the penicillin.

New Mold Makes Citric Acid

➤ CITRIC ACID, heavily used in soft drinks, confectionery and medicines, is nowadays produced mainly by mold fermentation. An improvement in this process is the subject of U. S. patent 2,400,143, which has just been issued to Prof. Selman Waksman, of Rutgers University, best known as discoverer of streptomycin and pioneer investigator of antibiotics generally.

One difficulty that has beset mold production of this acid is that the mold culture also produces oxalic and gluconic acids at the same time, necessitating costly separation processes. Prof. Waksman uses a different species of the Aspergillus mold from that commonly employed, and conditions the sugar solution on which it feeds with salts of iron and zinc. He states that in this way he is able to obtain an output of practically pure citric acid.

Rights in his patent are assigned to Merck and Company, Inc.

Iodine-Bearing Bandage

➤ AN ELASTIC BANDAGE which carries on one face an antiseptic charge of iodine is offered by Dr. C. J. Cavallito of Rensselaer, N. Y., for patent 2,400,389. The base of the bandage consists of rubber hydrochloride. This material does not absorb any significant quantity of iodine, but when it is treated with butyl stearate or other elasticizer it absorbs the drug quite readily, and afterwards releases it slowly. Accordingly, Dr. Cavallito coats one face of the rubber hydrochloride with a layer of the same substance that has been first plasticized and then immersed in a water solution of iodine. Rights in the patent are assigned to the Wingfoot Corporation of Akron, Ohio.

Dehydrating Fruit Juices

➤ THREE PATENTS, nos. 2,400,458 to 2,400,460, have been issued to Joseph M. Hall of Chicago on apparatus for dehydrating liquids such as fruit and vegetable juices into powder form. The liquid is fed into the drying chamber through a rotating hollow shaft which ends in a set of whirling spray nozzles, so that the liquid is thrown out in minute droplets. As these tend to fall towards the bottom of the big, top-shaped drying chamber they are met by a rising current of hot air, which removes the water. As planned by Mr. Hall, the dehydration is a two-stage process, the liquid being concentrated in the first drying chamber, and the concentrate reduced to final dryness in the second.

Rights in the patent are assigned to the Drying and Concentrating Company.

Glass For Fluorescent Lamps

➤ A MORE EFFICIENT glass for fluorescent lamps is covered by patent 2,400,147, issued to Dr. Joseph G. Hooley and assigned by him to the Corning Glass Works. He uses phosphates of tin and manganese, which are particularly sensitive to ultra-violet radiations at the wavelength 2540 Angstrom units.

Plastic That Explodes

➤ SYNTHETIC PLASTICS have been made out of almost all imaginable materials; now comes one that has TNT for one of its ingredients, and is ex-

plosive. It is the production of two Philadelphia chemists, H. A. Bruson and G. B. Butler, who have assigned rights in their patent, No. 2,400,806, to the Rohm and Haas Company.

The new explosive synthetic resin contains, besides TNT, formaldehyde and ammonia, or any one of a number of more complex organic compounds related to ammonia, known collectively as amides. It can be molded into any shape desired, like any other plastic, and it comes out with a smooth, hard finish.

The explosive plastic burns freely and fiercely in air, and can therefore be used for flares and rocket charges. It is also useful as a binder or carrier for less cohesive explosives, such as TNT, guncotton, nitroglycerin and tetryl.

Separator For Powders

➤ HIGH-TEST GASOLINES are compounded out of various hydrocarbons, with fine-grained, powdery catalysts assisting in the process. These catalysts are costly, and it is desirable to salvage them for re-use.

To separate these valuable powders from the gasoline vapors, Lyman C. Huff of Chicago has devised a simple method. The particle-bearing vapor is blown into a spinning vortex in a cyclone separator, where centrifugal force carries the heavier particles to the walls. Arrested there, they slide down into the bottom of a hopper. Then the vapor, still carrying the finer, dust-like particles, is forced through the mass of larger particles, where the fine stuff is sorted out. The vapor, emerging particle-free, progresses to the next step in its conversion.

Patent 2,400,645, issued on this invention, is assigned to the Universal Oil Products Company.

Combating Costly Slimes

➤ BACTERIA, molds and algae that form slimy masses in pipes, condensers and other containers of water are often costly nuisances to power plants, sugar refineries, paper mills and other manufacturing establishments. Various chemicals have been used against certain specific groups of these low forms of plant life, but none of them has been able to kill all the pests. William H. Allen of Midland, Mich., states that sodium 2,4,5-trichlorophenolate, used with copper sulfate or other copper salt, cleans all the slime-makers up nicely. Rights in his patent 2,400,677, are assigned to the Dow Chemical Company.

Seaweed in Ice Cream

➤ A SEAWEED preparation, chemically a compound of calcium and alginic acid, helps to give a smooth texture to ice cream and to stabilize its protein content. On this, Victor C. E. La Cloahec of Rockland, Maine, has received patent 2,400,834.

Absorbent Gel

➤ A HARD, glassy gel that is a good absorbent for poison gases has been made by Walter A. Patrick, Jr., of Mount Washington, Md., to whom patent 2,400,709 has been issued. A colloid dispersion of alumina is first made, using weak acetic acid. Then urotropin or formin is added. This converts the dispersion into a gel, which on drying is ready for use in military or industrial protection.

De-Smelling Oil

➤ ANYONE who has been near an oil well or an oil refinery knows that many varieties of crude petroleum

have a most foul smell. F. A. Kent and C. W. Patrick of Midland, Mich., get rid of this by adding first a milky slurry of lime, then hydrochloric acid, and agitating thoroughly. Their patent is No. 2,400,515.

Double Lamp

➤ A FLUORESCENT LAMP in which the tube is not straight but bent into a long, narrow U-shape, is the invention of Edward B. Noel of Cleveland Heights, Ohio. Both ends fit into a double-terminal metal base. Rights in the patent, No. 2,401,228, are assigned to the General Electric Company.

New Polarizer

➤ TRANSPARENT SHEETINGS that polarize light passing through them usually accomplish this result by means of embedded fine crystals with their long axes parallel. John F. Dreyer of Cincinnati has developed a polarizing film without any crystalline structure; its molecular structure gives it polarizing properties. On this he has received patent 2,400,877.

Ten Tons of Nazi Patents

➤ TEN TONS of Germany's best scientific and industrial know-how is being sorted out for American use.

Seized by the United States Army in Germany, 146 packing cases that contain 10 tons of documents from the German Patent Office have been brought here for evaluation. The job of picking out the material most important to American industry and science has been assigned the Office of the Publication Board of the Department of Commerce and the United States Patent Office.

When the documents have been checked, the most useful will be published here.

The rest of the cache will be returned to Germany to help reestablish the German Patent Office, it was announced.

Colchicine Speeds Plant Growth

➤ COLCHICINE, the "evolution chemical" that has been used to originate new species of plants by multiplying the heredity-bearing chromosomes of old ones, also has the power of greatly speeding up plant growth when used in weaker concentration, Prof. Earl H. Newcomer of the University of North Carolina has found.

Prof. Newcomer used colchicine in a four-tenths of one per cent solution. He placed one drop of this per day on the growing points of young oak and chestnut trees, hazel bushes and other plants. In some cases the treatment produced unfavorable results, even death, but in 16 seedlings of the species named he found that growth went on at double the usual rate.

In previous researches by two Chinese researchers, T. Loo, and Y. Tang, a speeding-up of seed germination in corn, rice, wheat, cabbage and mungo bean had been reported.

Chemical Magic

Pour Water From Empty Glass

by Joseph H. Kraus

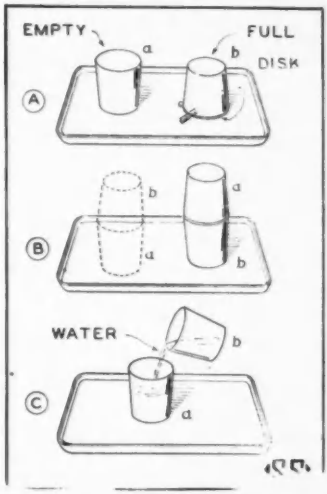
➤ You can surprise your friends by pouring water from a glass which they assume to be empty. A full glass of water can be turned upside down without having any water pour out. It can be placed on a tray in an upside down position and picked up again with the water still in it. It can be used with a duplicate glass that is obviously empty so that the full glass is also believed to be empty and the water in the glass seems to "come out of thin air."

The trick lies in placing a transparent plastic film, cut to fit the glass, over the top of the glass full of water.

To prepare the experiment, cut a disk of transparent celluloid to fit the mouth of a drinking glass that has a smooth rim. The celluloid can be obtained from a piece of photographic film from which the emulsion has been washed. The film can be cut with a pair of scissors. Leave a small tab projecting from the celluloid disk so the film can be removed easily later in the demonstration.

Fill the glass with water. Now set it down on a level surface and add a little water at a time until the glass is more than brim full. Surface tension will permit you to do this.

Let the glass stand for a few minutes until all the air bubbles in the water have been released, then lay the celluloid disk on top of the glass of water, pressing it down flat so the



film is in close contact with the water and the glass. Hold the disk in place with your hand and turn the glass upside down. This should be done over the sink so that if the film slips, you will not get wet.

Take your hand away from the disk. The water will not pour out and you will be able to carry the glass upside down without spilling a drop. If you have not allowed air bubbles to get into the glass, it will appear empty.

As long as the film, which holds the water surface flat, does not slip or the seal between the glass and film is not broken, the pressure of the air on the film will hold the piece of transparent film over the glass. The

film across the glass leaves only a small area through which the air can force its way in and the surface tension of the water will be great enough to keep the air from forcing in between the rim of the glass and the film, causing the water to run out.

Now, having prepared the demonstration, set the glass of water on a dry tray. Put a match stick under the edge to keep the celluloid film from sticking to the tray when you lift the glass again. This is illustrated at A in the diagram.

Now pass among your audience an empty glass that is a duplicate of the one you have just filled. After all have examined it, place it beside the other glass on the tray. Pick up the full glass by the bottom and place it directly on top of the empty glass, as shown at B, fitting them rim to rim. Squeeze the two glasses together and turn them over so that the empty one is on top.

It is now safe to remove your film, but this should be done so that your audience will not notice it. The best way is to hold a handkerchief by two corners behind both glasses, asking if the audience would like to have you cover the glasses or prefer to see what is going on. Your friends will undoubtedly insist that the glasses remain in full view. As you prepare to discard the handkerchief, grasp the celluloid tab, pull it out from between the glasses and toss the handkerchief with the film to one side.

Now you finish the trick by pouring the water from what may have been thought an empty glass into the one that is now empty.

Fiberglass Mats Wrap Underground Pipes

➤ FIBERGLAS mats, developed originally for use in storage batteries, are now found to be valuable in several other applications. They are employed with success for wrapping underground oil, gas, and other pipe lines to protect them against electrolytic action and corrosion; as a base for a new plastic laminated material; and sheet packing. These mats are made by the Owens-Corning Fiberglas Corp.

Glass fibers are non-corrosive to metals and have negligible moisture pickup. The mats of this material can be wrapped around bitumen or coal tar-coated pipe, thus forming a continuous water-tight bond. The tensile strength of the material withstands a wide range of temperatures, and exposure to organic solvents and soil acids.

The new plastic laminated material in which fiberglas is used, has many electrical uses because it possesses a low and stable loss factor over a wide wave frequency range. It is employed in plastic coil forms, condenser spacers, stand-off insulators, and in radio television and other high-frequency electronic devices.

In the base material for gaskets and sheet packing, the mat acts as a carrying medium for synthetic resins suitable for applications requiring resistance to heat, oil and acids. The gaskets show high pressure resistance, good chemical durability and little flow under flange pressure.

Deadliest Germ Poison Produced From Botulinus

Camp Detrick Discoveries

by JANE STAFFORD

➤ THE UNITED STATES has a weapon of germ warfare so powerful that one ounce of it would wipe out almost the entire population of North and South America combined. This is the botulinus toxin, until recently known chiefly as the cause of particularly dangerous food poisoning against which home and commercial canners carefully guard their canned vegetables and meats.

The poison has been obtained in pure form by our biological warfare experts working at Camp Detrick, Md. Figures given with the scientific report of the method of purifying the toxin show that one ounce of the pure white, needle-shaped crystals could kill 200,000,000 men, each weighing 165 pounds. For women and children, the killing dose would probably be smaller.

These are facts behind the undetailed revelations of Naval biological warfare researches made in Congress recently.

This deadly stuff, believed the most poisonous known substance per unit of weight, is only one of the weapons of germ warfare forged by our scientists during the war.

Gardeners and farmers are using another of them this summer to rout dandelions from peaceful lawns and wild mustard from fields of small grains that will help to feed the hungry world. The new weed killer, 2,4-D, or some of its chemical relatives might have been used for destruction of enemy crops. Over 1,000 such compounds were prepared and tested, the Special Projects Division of the Chemical Warfare Service at Camp Detrick recently announced.

Germs of anthrax, of psittacosis, or parrot fever, of undulant fever and of tularemia, or rabbit fever, may have been other germ warfare agents we had ready in case of need. Studies on all of these were reported by Camp Detrick scientists at the meeting just over of the Society of American Bacteriologists. While these germs are not so deadly as the botulinus poison, they cause incapacitating sicknesses, some of them with frequent relapses, that could make large numbers of troops ineffective or slow production of munitions workers.

Weapons of defense against germ warfare were also forged at Camp Detrick and other biological warfare stations. A vaccine to protect against rinderpest, cattle disease capable of wiping out entire herds of meat and draft animals, has been announced. Vaccines against two highly fatal poultry maladies, Newcastle disease and fowl plague, were also produced. Vaccines against psittacosis and tularemia were developed at least to the stage of protecting laboratory animals. These and other defensive weapons such as faster diagnostic methods and improved treatments will prove peacetime benefits of work on war weapons which rival the atomic bomb in deadliness without its almost prohibitive cost.

—Courtesy Du Pont Co.

➤ TODAY *the range of aromatics available to the perfumer consists of perhaps a thousand raw materials.*

Modern Science and Ancient Lore Combine In the Formula of an Exotic Perfume

Scent From the Isle of Cyprus

A chapter from the book THE SCIENCE AND ART OF PERFUMERY *(McGraw-Hill Book Co., 1945 - $3.00.)*

by EDWARD SAGARIN

➤ THE FRAGRANT VAPORS that are "confined in the smallest glasses" tell a story of romance and history and adventure. The ingredients have come from all parts of the world, from the Himalaya Mountains to the jungles of Brazil. They come from the labor of the peasant and the research of the chemist. Each ingredient has a history of its own, and all of them, blended together with skill and experience, in a proper proportion, give the result, the desired perfume.

The literature of perfumery is filled with formulas, dating back thousands of years, and in the safes of the perfume houses there are literally hundreds of thousands of unpublished recipes. We shall not add one more here, but rather take a leaf out of a well-known volume and examine it, see how many ingredients a single formula might contain, where they come from, what they smell like, in what proportions they are used.

Any formula that one could choose from a modern and adequate book would demonstrate the essential unity of natural and synthetic products in the blending of a finished perfume. Hardly a formula could be chosen that would not illustrate the romance and the science of perfumery, or that would not include many of the natural oils, plant and animal resins, and synthetic organic chemicals which we have been discussing.

The formulas for the blending of a perfume whose odor duplicates that of a natural flower are, in general, easier to judge than those that create a new odor.

There are, in addition, large numbers of perfumes which are neither simulations of natural odors nor complete departures from known scents. They are continuations, duplications, refinements, and modifications of the new bouquets of years gone by. It is in this class that one can place an eaù de Cologne, although one creation using that name may differ greatly from another; and it is also in this category that one can place the formula of Felix Cola, which we shall analyze in detail.

Here is the odor called "chypre." The name itself has a history, one of the perfumes that came from "the glory that was Greece," from the island of Cyprus, whose French name is "chypre," and whose Biblical name was Chittim, suggestive of shittim wood, a variety of acacia, and referred to in the Scriptures as a sacrifice, in the same passage with spices, oils, and incense.

Hundreds of chypre formulas can be discovered, each with a special character of its own, but with all their differences there is a red thread of continuity that runs through many of them—oakmoss and bergamot.

CHYPRE

by FELIX COLA

Santalol	60 grams
Coumarin	90
Musk ketone	30
Musk ambrette	20
Absolute ambrein	25
Oil of estragon	25
Angelica root	5
Sage clary	30
Vetiverol	60
Linaloöl	30
Patchouli	20
Isoeugenol	35
Methyl ionone	50
Oakmoss absolute	60
Bergamot	225
Jasmin absolute	20
Rose absolute	15
Methyl salicylate	2
Lavender	3
Vanillin	15
Heliotropin	35
Ylang ylang Manila	70
Cinnamyl acetate	25
Benzoin gum resinoid	50
TOTAL	1,000 grams

What are these ingredients?

Santalol, as its name suggests, is an alcohol found in the oil obtained from the sandalwood tree. "Sandalwood," writes Richard Le Gallienne, "has a history that goes back five hundred years B.C. The product of an Indian tree, it is still a sacred perfume for religious and funeral rites among the Indian and Chinese Buddhists, and the trade in it in old sea-faring days was full of romantic peril."

Coumarin, whose synthesis was a landmark in the history of perfumery and organic chemistry, obtains its name from the tree that the botanists call the "Coumarouna odorata," of which the tonka bean is the fruit. In 1875, an American perfumer by the name of Clifford wrote a curious and melodramatic poem, from which we quote a few lines:

'Tis thus we find the Tonka tree,
Sprang from a maid beneath the sea;
Tonka, her name, means "fairest in the land."
Redeemed, the maiden's pledge she gave,
The while she sank beneath the wave,—
"I go to give my lovers, each, my hand."

Musk ketone, called the sweetest of the artificial musks, is closest to the natural musk in its odor. The creation of Baur, its synthesis is closely linked with the beginnings of synthetic aromatic chemistry as an independent industry.

Musk ambrette, the second of Baur's permanent contributions to perfumery, has been called one of the most powerful odorants known. Its name is derived from a pear-like fruit with a musky odor, which is probably best known in our language because it is the namesake of this synthetic.

Absolute ambrein comes from gum labdanum, whose history is dated back to Genesis, where it was confused with the gum known as myrrh. It has a powerful, pleasant, and musky odor, suggestive of the whale's ambergris, as the similar names would indicate.

Oil of estragon is not commonly encountered in a perfumer's notebook. It is a spicy flavoring oil that is derived from a French herb, better known to the public under the name of "tarragon."

—Courtesy Du Pont Co.

➤ PERFUMES *are judged and compared by putting a drop of each on a strip of blotting paper.*

Angelica root, frequently encountered in a chypre formula, is an oil distilled from the roots of a plant whose white flowers inspired its heavenly name. Its odor is strong, spicy, and pleasant, and while the commercial roots come from Europe, the plant is known to be abundant among the vegetation in the jungles of New Guinea.

Sage clary is distilled from an herb that thrives in France. Little known outside of the realm of the perfumer and the flavorist, it is not infrequently met in chypre odors. Its fragrance is classified as akin to ambergris, labdanum, and musk ambrette.

Vetiverol, an alcohol, like santalol, is what the industry calls an "isolate;" it is a substance found in the oil obtained from the root of the vetivert plant. The history of vetivert goes back to the days of the Arab navigators. It is today produced in the rich essential-oil islands of Java and Réunion, and its disappearance from the market during the war was as severe a hardship as any the perfumer had to face. Constituting 6 per cent of this chypre formula, its characteristic odor will be readily discerned by a trained perfumer.

Linaloöl is an alcohol found in a wide variety of oils, in Brazilian bois

de rose, in the linaloe wood and its seed, from which it derives its name, in the Sicilian bergamot, the South American petitgrain, the British lavender. It comes from oils found in every part of the world but retains a slightly perceptible character of the oil from which it has been produced. Its history goes back to the Bible, its nomenclature to the wood oil, the aloes.

Patchouli is the oil obtained from the dried leaves of a plant found in Malaya and Sumatra. In the words of the French author, J. K. Huysmans, it is "the most pronounced of all vegetable perfumes, whose blossom, in the natural state, gives off an odor compounded of wet wood and rusty iron."

Isoeugenol, often known as the "carnation" odor, in a natural state is found in oil of ylang ylang, but is quite easily made from eugenol, a constituent of clove oil.

Methyl ionone is one of the creations of the chemist that has never been discovered in the natural state. Its production depends on the availability of citral, an ingredient of oil of lemongrass, itself an Indian oil, and the coal-tar derivative, methyl ethyl ketone. With all the beauty of the violet note of ionone, it has a pinelike characteristic of its own.

Oakmoss is not a moss, nor does it necessarily grow on or around the oak tree. It is a resinous substance coming from a lichen and is said to have originated as a perfume substance on the island of Cyprus. In modern times, the best quality originates in the interior of Yugoslavia. The story of the ten tons of oakmoss that escaped from Yugoslavia just before Hitler's armies marched in, and was buffeted from port to port for twenty months, finally to arrive within a few hours of its final destination, is one of the thrillers of perfume history. For the oakmoss that had survived the fortunes and misfortunes of war never made the last mile; the ship struck a rock and was sunk off the coast of Boston.

Bergamot is Sicily's outstanding contribution to the industry of odors. Linguists trace its name back to the Turkish, *beg-armudi*, which means the "prince's pear." The oil comes from the pear-shaped fruit that grows on the tree of the same name. The eighteenth-century English poet, William Cowper, wrote of his fondness for this scent: "Give the nose its bergamot."

Jasmin is a legend in perfumery. No flower is more revered, more elusive. No odor has so successfully withstood the challenge of the synthetic, commanding a fantastic wartime price in many lands during the Second World War. Pounds, even ounces, were hidden in caches by daring underground workers during the days of the German occupation of southern France. In 1883, in words as prophetic as they were poetic, Huysmans described jasmin as "admitting no imitation, no counterfeit, no copy, which refuses even any approximation."

Rose, a favorite wherever flowers are in bloom, has chosen a few spots on earth to give blossoms that yield oils for the perfumer—Bulgaria, known for its otto of rose—Turkey, a link between Asia, where the attar was said to have originated with the Persians, and Europe, where it is now developed—and, as always, the Rivi-

era. The literature of all tongues is filled with songs of this fragrance, captured by Swinburne in these lines:

What fields have bred thee, or what groves
Concealed thee, O mysterious flower,
O double rose of love's
With leaves that lure the doves,
From bud to bower?

Methyl salicylate, minty, pleasant, and rather pungent, is almost identical with natural oil of wintergreen, and is today made synthetically from coal-tar derivatives, through the intermediate compound, salicylic acid, which can also be readily transformed into aspirin. Though present in the formula under consideration only in the quantity of 1 part in 500, its influence will be felt. Seldom, in fact, can this pungent odor be used in a fine perfume except in minute quantities to give a trace effect.

Lavender, an odor associated with a color, comes from a plant grown in southern France and in parts of England, and is a favorite odor of the British. The English oil is generally placed at a higher value than the French. Many authors have shown a fondness for lavender, but what was our surprise to find this delightful quotation—of all places—in Sir Izaak Walton's *The Compleat Angler* (Chap. 2):

➤ MUSK GLANDS *contribute a characteristic factor to traditional perfume formulas.*

—Courtesy Givaudan-Delawanna, Inc.

"An honest Ale-house where we shall find a cleanly room, Lavender in the Windows, and twenty Ballads stuck about the wall."

Vanillin, once the costly chemical isolated from the vanilla bean, today traces its ancestry to the waste liquors of a paper mill, to the by-products of a chemical plant producing moth-proofing agents, or to Madagascar's oil of cloves, whose carnationlike isoeugenol, already placed in this formula, can be oxidized to vanillin.

Heliotropin is made from safrole, found in America's own sassafras, the flavoring ingredient of root beer. However, the domestic safrole-bearing oil is not a commercially practicable source for heliotropin. This chemical derives its name from the flower whose odor it resembles. "On the darkest day of the year," writes Mary Webb in *The Spring of Joy*, "with sleet in the air, you can find in the sombre shelter of a yew-tree a pale blossom scented like heliotrope. It is only the wild butterbur, yet its delicacy lifts the wintry day on to the steps of summer."

Ylang ylang obtains its repetitious name from its meaning, the flower of flowers. The tree whose flowers give this oil is grown in Thailand, Réunion, the Philippines, and elsewhere, but perfumers are unanimous in their preference for the Philippine oil.

Cinnamyl acetate, though named for a substance found in cinnamon oil, is not prepared from the natural oil. By a process worked out by the great chemist, Claisen, benzaldehyde and acetaldehyde are condensed to form cinnamic aldehyde; in a delicate operation requiring the use of aluminum, the aldehyde is transformed into an alcohol, which in turn is used for making cinnamyl acetate.

Benzoin resinoid is an extraction from benzoin tears, which originates in French Indo-China and Thailand. It is not quite as viscous as other resins, but has the equally valuable fixative properties, together with a sweetish note of its own.

Here, then, is a perfume formula, as typical as any. None of the substances smells like the finished perfume, but, added together in the given proportions, they produce the odor known as chypre. Another formula might start with the specialty of a Swiss or French laboratory, might have more animal products, or other types of oils or synthetics.

The originator of such a formula might have sat back in self-satisfaction in his laboratory, in disregard of the harsh realities of a world at war. He might have lived in a world of his own creation, if such were his desire —were it not for the events that led up to Dunkirk and Pearl Harbor.

The natural oils in this formula come from southern France, Yugoslavia, Bulgaria, and other spots in Hitler's erstwhile empire. They come from Madagascar and Réunion, for a long time cut off from America; they come from such places as Java, Sumatra, Thailand, French Indo-China, the Philippines, all once held by the Japanese, and from India, where boats traveled only for the most essential purposes. It would be difficult to name a group of raw materials that became less available to their users than natural essential oils during the war.

—Courtesy Du Pont Co.

➤ FLASKS *of terpineol reflect casks and drums of other synthetic ingredients of modern perfumes.*

The situation in aromatic chemicals was not much more encouraging. We are wont to think of chemicals for war in terms of poison gases, explosives, and perhaps such medicinals as the sulfa drugs. The chemical industry, however, is to a tremendous extent an "intermediary industry," the supplier of goods that never see the light as end products in themselves, but that are used in the development of everything around us—of metals, textiles, food, medicines, soaps, paints.

In the tremendous consumption of chemicals for war purposes and for the essential well-being of our country, materials were used that otherwise might have been available for the manufacture of perfume chemicals. The shortage of aromatic chemicals was therefore traceable, not to their use in making synthetic rubber or explosives, but to the fact that the aromatics had to compete with synthetic rubber for the same raw materials.

We have mentioned a number of coal-tar derivatives. Benzene, for instance, is the starting material in the most important process for the manufacture of phenyl ethyl alcohol, and the latter in turn, in addition to its

widespread use for its rose odor, is the starting material for the production of phenyl ethyl acetate, phenyl ethyl propionate, and a group of similar esters.

Nor does this end the dependence on benzene. It is also used in the manufacture of benzophenone and acetophenone, and in the manufacture of nitrobenzene, which is used in producing eugenol vanillin.

The story of dependence on benzene can be repeated with toluene, which is used by the petroleum and explosive industries, among others. From toluene is made benzyl chloride, which is the raw material for the manufacture of phenylacetic acid, benzyl alcohol, benzyl acetate, benzyl benzoate, and related products. But its most vital use to the field of perfumery is in the synthesis of benzaldehyde, either by a process of direct partial oxidation to the aldehyde, or through benzyl chloride, benzal chloride, and benzyl alcohol as intermediates.

Benzaldehyde, short in supply because of its dependence on toluene and due to the military usages of the aldehyde itself, is used by the aromatic chemical manufacturer to make cinnamic aldehyde and phenyl acetaldehyde, which in turn are the raw materials for cinnamic alcohol, phenyl propyl alcohol, and any number of other important aromatics.

Our story could be continued to show the dependence of the industry on formic acid, acetic acid, orthocresol, ethyl alcohol, and acetone, or we could go through the formula books, taking the synthetic musks, the aromatic and the fatty aldehydes, and other organic chemicals and show why each aromatic was in short supply.

Aside from the fact that there was not a single material in this formula easily obtainable during the war, our perfumer found his calculating machine giving him fantastic costs of production. Bergamot, making up some 22 per cent of the formula, increased two and a half times in price from the eve of the outbreak of the Second World War until the beginning of 1945. By 1945, patchouli cost about nine times the prewar figure, and oakmoss, if a pound could be obtained, would have changed hands at several times its former price.

Jasmin and rose absolute, two items that together made up more than a third of the cost of the perfume before the war, increased some tenfold in the case of jasmin absolute, and fivefold for a given quality of otto of rose.

For his raw materials (exclusive of labor, packaging, and other expenses) it cost a perfumer from $25 to $30 to make up one pound of this perfume base in 1939, and between $125 and $130 for the same base in 1945.

In an analysis of this price rise, published in *The Givaudanian* of August, 1941, before the situation had gotten completely out of hand, Eric C. Kunz pointed out that increases in price were traceable to the inflationary trends in essential oils and other naturals, whereas aromatic chemicals had resisted such price rises.

"The maior increase in the cost of any formulation," this writer pointed out, "is due to the flower oils and the oleoresins and similar fixatives, and

only to a very slight extent is such an increase traceable to the truly synthetic products. Synthetic aromatic chemicals derived from coal tar contribute the least toward inflationary prices of formulations.

"Perceptibly higher prices are now asked for isolates or derivatives from essential oils, such as the ionones derived from oil of lemongrass, the price of which has increased from thirty cents to $1.90 per pound. If one pound of lemongrass were needed for one pound of any given ionone or methyl ionone, the situation would not be so bad, but on the average we need two pounds of oil of lemongrass to make one pound of ionone of medium quality. If products of especially high purity are desired, we need three, four—and in some cases ten—pounds of oil of lemongrass in order to produce one pound of the finished ionone."

Under these circumstances, many perfume formulas have undergone changes. Few formulas could remain untouched by the cataclysmic events in the Atlantic and Pacific. But it is a tribute to the industry that perfumes of all types of odors, and of undeniably high quality, have been produced without interruption. The chemist has created a little where there was none, and the perfumer has made a little go a very long way.

On the Back Cover

➤ Roses *yield an oil which has been a favorite for perfume since attar of roses originated centuries ago in Persia.*

ACS Meeting and Show in Chicago

➤ The Semi-Annual Meeting of the American Chemical Society and the Fourth National Chemical Exposition will be held in Chicago September 10-14. The show is sponsored by the Chicago Section of the A. C. S. Headquarters are in the Coliseum administration building, 1513 South Wabash Avenue, Chicago 5, Ill.

Anarchy Among Rubber Molecules

➤ Retention of its stretchability by rubber depends on the maintenance of a state of internal anarchy among its molecules, Dr. W. O. Baker and Dr. N. R. Pape, of the Bell Telephone Laboratories, reported to the American Chemical Society.

X-ray studies of natural rubber stretched and stretched again until it stiffened and lost its elasticity showed that the molecules had assumed an orderly, crystal-like pattern. Types of synthetic rubber that do not thus become brittle under strain showed X-ray patterns indicating that their molecules never became really orderly.

American Occupation Forces Teach Hydroponic Farming

Soilless Gardens in Japan

➤ THE WORLD'S BIGGEST soilless gardens, where vegetables are raised in long beds of gravel on water solutions of fertilizer chemicals, are now under construction in Japan. Details of the gardens, which will supply green salad vegetables for our occupation forces, have been disclosed by Lt. Col. Ewing Elliott of the Eighth Army, in charge of the project.

Over-all area of the gardens (or perhaps farms would be the better word) is 80 acres, divided into two sections—55 acres at Chofu, near Tokyo, and 25 acres near Otsu, about six miles north of Kyoto. Each consists of a series of long, shallow concrete troughs, filled with washed river gravel, through which the solution of chemicals is flowed every two days, to maintain moisture and feed the plants.

In similar but much smaller gardens used during the war, tomatoes, lettuce, radishes, cucumbers and green peppers were grown successfully. To this basic five Col. Elliott expects now to add green onions, carrots and spinach for salad purposes. Japanese labor will be employed throughout; it is expected that 1,000 men will be kept busy raising greenstuffs for the American forces in Japan.

This method of producing vegetables was adopted for two reasons: Japanese methods of cultivation make it unsafe to eat any of their produce raw, and in any case Gen. MacArthur wants every acre of Japanese farm land devoted to the task of staving off famine among the Japs themselves.

Japanese agricultural scientists are very much interested in the project, seeing in it a possibility of increasing food production in their over-crowded country. The unversities of Tokyo and Kyoto are coperating, as well as the Ministry of Agriculture. Col. Elliott's principal assistant is a horticulturist named Tanaka, formerly a professor in the Japanese university on Formosa. Fifty university graduate students have asked to be taken on as laborers, to get a chance to learn the technique.

Soilless gardening got its first large-scale try-out on barren Ascension island, just south of the equator in mid-Atlantic, where there was a large American airbase during the war. The area of this garden, however, was only two and one-half acres, as compared with the 80-acre installation in Japan.

One two-acre soilless garden is now in operation on Iwo Jima, and additional moderate-sized ones are planned for some of the other Pacific islands where American troops are stationed.

Soilless gardening, or hydroponics as it it technically called, is a strictly American invention. It is an application on an actual grow-for-eating scale, of a laboratory experiment often performed by students.

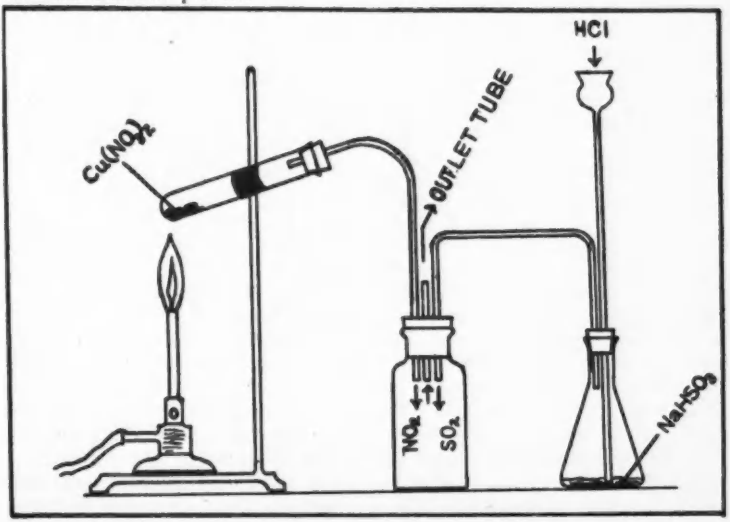
Manufacture of Sulfuric Acid

by Burton L. Hawk

▶ Sulfuric acid—"King of Chemicals"—is perhaps the most useful compound ever manufactured. It can be used as an acid, catalyst, dehydrating agent, oxidizing agent, electrolyte and solvent. It plays a major role in the manufacture of fertilizers, dyes and drugs, paints and pigments, explosives, textiles, etc. It is used in the refining of petroleum, in pickling of steel, in metallurgical processes, for the manufacture of other important chemicals, in storage batteries, and in many other industries too numerous to mention here.

Sulfuric acid is not easily manufactured. The dioxide of sulfur, SO_2, is a complacent compound and thus is reluctant to accept another atom of oxygen to form the trioxide, SO_3, which is the anhydride of sulfuric acid. To bring about this transformation, the chemist must use rather persuasive methods, such as employing a catalyst. Sulfur dioxide and air are heated and passed over the catalyst,

▶ Laboratory set-up *which will allow the novice in chemistry to duplicate on a small scale the reactions by which sulfuric acid is made in the commercial Lead Chamber process.*



which usually consists of mixtures containing vanadium pentoxide. Sulfur trioxide is formed, $2SO_2 + O_2 \rightarrow 2SO_3$, from which acid is produced.

Another method utilizes the action of the oxides of nitrogen on sulfur dioxide. This is the method which can be demonstrated in the laboratory. Commercially, it is known as the "Lead Chamber" process.

First, secure a flask to be used as the "Lead Chamber", or reaction flask, and fit it with a three-hole rubber stopper. Now we must supply a source of sulfur dioxide. This is most conveniently prepared in the laboratory by the action of HCL on sodium bisulfite. Place four grams of the latter in a flask and just cover it with water. Fit the flask with a two-hole stopper, thistle tube and delivery tube. The end of the thistle tube should be just under the surface of the water in the flask. The delivery tube should lead to the reaction flask. Next we must supply a source of nitrogen dioxide, which can be obtained readily by heating the nitrate of a heavy metal such as copper or lead. Place three grams of copper nitrate in a dry test tube. Clamp in an inclined position and fit with a stopper and delivery tube leading to the reaction flask. An outlet tube is placed in the third hole of the stopper in the reaction flask. This can be connected to a rubber tube leading the offensive gases away, or the gases may be "absorbed" in water, after first passing through an empty bottle serving as a "trap". This rather elaborate apparatus can be set up in several ways. The accompanying diagram suggests one method.

Now, if you are still with us, let us proceed with the reaction. Heat the copper nitrate until the reaction flask is filled with brown fumes. Then pour hydrochloric acid through the thistle tube of the SO_2 generator. Allow the two gases to flow into the reaction flask, keeping the NO_2 slightly in excess. After a while, thin white crystals will form in the flask, and will dissolve in any water that may have condensed, forming numerous droplets of sulfuric acid. After you have choked considerably from the fumes, discontinue the reaction and disconnect the apparatus. Pour a little water on the crystals that have formed. Notice the sizzling sound. Sulfur trioxide reacts with the water to form sulfuric acid: $SO_3 + H_2O \rightarrow H_2SO_4$. Pour a portion of the acid into a solution of barium chloride. A heavy white precipitate indicates the presence of the sulfate radical. Test the strength of the acid by adding a small piece of zinc; it should react, liberating hydrogen.

Of course this method is not practical, being designed solely for demonstrative purposes. In the commercial Lead Chamber process, the sulfur dioxide is produced by burning sulfur or iron pyrites. The oxides of nitrogen are produced by the catalytic oxidation of ammonia. The two gases, along with air, are led into the Lead Chamber where steam is introduced. Reaction occurs, producing *nitrosyl* sulfuric acid: $2SO_2 + NO + NO_2 + O_2 + H_2O \rightarrow 2NOHSO_4$, which in turn reacts with more water forming sulfuric acid: $2NOHSO_4 + H_2O \rightarrow 2H_2SO_4 + NO + NO_2$. You will note that the oxides of nitrogen are again produced by the second reaction. These are collected and used over again.

Chem Quiz

A Chemical Word Square

➤ For a vacation amusement, see how many chemical terms you can find in this word square. Begin anywhere, move to the adjoining square, either straight or on the diagonal, use the same letter over again if you wish. You can see *zinc* quite clearly in the lower right-hand corner. A list of words that we found is on page 40, but we are sure you can do better.

F	T	P	Y	R	M
V	A	L	O	B	E
D	M	C	A	R	P
E	I	U	I	O	C
L	S	D	T	N	Z
E	H	A	E	L	I

Atomic Bomb Chemists Plan New Projects

➤ Accompanied by a number of his collaborators in research on the separation of plutonium for the atomic bomb, Dr. Glen T. Seaborg, professor of chemistry at the University of California, has returned to Berkely to take active charge of the University's atomic chemistry research program.

Dr. Seaborg and his group, working in collaboration with the large aggregation of nuclear scientists already gathered in Berkely, headed by Prof. Ernest O. Lawrence, cyclotron inventor, and Prof. J. Robert Oppenheimer, noted theoretical physicist, will be concerned primarily with the chemistry of the heavy elements and the search for new transuranic elements beyond 96.

Dr. Seaborg, whose program is under the direction of Prof. Wendell Latimer, dean of the college of chemistry, has stated that there is good reason to believe that new elements going beyond 100 will be discovered.

Dr. Seaborg has been on leave of absence to the University of Chicago's Metallurgical Laboratory since 1942, directing the work on the separation process for plutonium, of which he is a discoverer with Drs. Edwin McMillan, J. W. Kennedy, A. C. Wahl, and Emilio Segre.

Others who have returned to the University of California with Dr. Seaborg from Chicago include: Dr. I. Perlman, Dr. S. J. Thompson and Dr. Burris Cunningham, who played major roles in the plutonium project; L. O. Morgan, a co-discoverer with Dr. Seaborg of the new element, 95, americium; Albert Ghiorso, a co-discoverer with Dr. Seaborg of the new element 96, curium; and R. A. James, a co-discoverer of both these elements.

Surplus Knowledge of Nucleus Needed for Power Research

Atomic Energy Applications

➤ ATOMIC ENERGY has possible peacetime applications but only after intensive laboratory research in nuclear and related fields and the solution of many difficult engineering problems, Dr. C. G. Suits, vice-president and research director of General Electric, told the American Institute of Electrical Engineers.

"We have, during the war, largely used up our accumulated surplus of basic knowledge of the nucleus," he said. "The dividend was the atomic bomb. We must, without further delay, restore this surplus in preparation for the important peacetime job for the nucleus—power production."

The development of economical atomic power is not a simple extrapolation of knowledge gained during the bomb work, he continued. It is a new and difficult project and great effort will be required to reach a satisfactory answer. Needless to say, it is vital that atomic policy legislation now being considered by the Congress recognizes the essential nature of this peacetime job, and that it not only permits but encourages the cooperative research-engineering effort of industrial, government and university laboratories for this task.

In mentioning some prospective uses of atomic or nuclear energy, certain difficulties of production and installation rule out a host of low-power applications, he said. Automotive power is out. Railroad locomotive power is almost certainly out. Large ship propulsion seems not only possible, but attractive, but on a strategic rather than on a competitive basis. An advantage gained in the space required for fuel is partly offset by the space required for shielding; evidently a detailed research and engineering study will be required to evaluate this application.

Perhaps large electric power plants are in the running in areas, for example, Australia, where there is practically no conventional fuel but abundant natural resources of many other types. Atomic power plants for electric power generation will probably at some distant future time compete successfully with coal, oil and water power energized plants.

"But it should be borne in mind," he added, "that there is nothing in the present status of nuclear research to justify the hope of direct conversion of nuclear to electrical energy."

Before presenting these possible applications of atomic energy, Dr. Suits reviewed certain new physical facts. That energy may be produced by the disintegration of the nucleus is not one of the new facts, he stated. That has been known since the discovery of natural radioactivity 50 years ago. Radium is too rare and too expensive to be a factor in the power field.

The discovery of a new type of nuclear disintegration called fission, in 1939, is a new fact, Dr. Suits declared.

Fission occurs in uranium, thorium, and some other elements. Relative to radium, uranium is an abundant element. It comes by the pound and costs a few dollars per pound.

Only the isotope U235 undergoes fission and it is present as less than 1% of natural uranium. However, under the most favorable circumstances the bulk of natural uranium, suitably purified, is converted to fissionable elements, so that nearly all of it may be used to create nuclear energy. The fission of one pound of U235 produces 10,000,000 kilowatt-hours, he added.

Uranium in a pure condition, or enriched in the isotope U235, may be used in a chain reacting pile to produce controllable heat energy. This nuclear reaction in a pile goes at any temperature permitted by the materials of construction. These materials include the fissionable elements, the moderators, or slow-downers, the heat transfer medium, the various mechanical parts required for control, and finally the radiation shield.

Dr. Suits called attention to some of the difficulties in the process due to mechanical feeding, the accumulation of reaction products including toxic gases, and especially the neutron radiation from which workers must be protected.

The fission energy of one pound of U235 equals the heat energy of 1,000 tons of coal, he said, but the plants for the production of U235 and plutonium, element 94, are expensive to build and operate. Because of this cost, heat from a pile is not today competitive with heat from a device which burns conventional fuels.

Gas In Atmosphere From Soil

➤ THE EXISTENCE of the gas, nitrous oxide, in the earth's atmosphere in sufficient quantity to record on spectrum photographs of the sun has been established by Dr. Arthur Adel, of the Randall Laboratory of Physics, University of Michigan.

Dr. Adel has discovered and analyzed an absorption band at wavelength 7.77 mu in the infra-red photographic spectrum of the sun. This is a "telluric" band, which means that it is put into the spectrum by the selective absorption of sunlight as it passes through the earth's atmosphere. Telluric lines, such as those of oxygen and carbon dioxide, are easily recognized in most cases because they do not show the Doppler shift shared by lines originating in the sun's atmosphere and partaking of the sun's rotation and other apparent motions.

In recent examinations of soil air, M. W. Kriegel, of the Carter Oil Company, Tulsa, Okla., has found a gas which he believes to be nitrous oxide, and he suggests that this may result from the slow decomposition of commercial fertilizers in farming areas, since nitrogen is the common element in ammonium salts, nitrites, nitrates, and other fertilizers. Decomposing vegetable matter under aerobic conditions also gives off a gas having the properties of nitrous oxide. Dr. Adel suggests that soil air is thus probably the chief source of the "layer" of atmospheric nitrous oxide.

New Chemical Superior To Atabrine and Quinine

Aralen Combats Malaria

➤ A NEW ANTI-MALARIA drug will be in the drugstores of America probably by midsummer. The drug has been named aralen. It is one of the 14,000 substances tested for antimalarial activity by American scientists during the war. At that time it went under the name of SN 7618.

Better than atabrine and much better than quinine, was the verdict of scientists who tested the drug for the Board for the Coordination of Malarial Studies.

No yellowing of the skin goes with taking the white pills of SN 7618, or aralen. It does not cause stomach and gastrointestinal upsets. As a suppressive of malaria, it need be taken only once a week, compared to the daily dose needed when atabrine is used for the same purpose. As a remedy, the new drug stops an attack of malaria in 24 hours, while atabrine takes four to six days to bring about recovery.

Aralen is now being manufactured in commercial batches regularly, Dr. J. B. Rice of the Winthrop Chemical Co. reports. His company expects to have the drug available commercially within one or two months. The cost will probably be about the same as that of atabrine, Dr. Rice states, although no cost data are available yet.

Aralen, a member of the 4-aminoquinoline series of chemicals, had been made by German chemists at the I.G. Farbenindustrie plant at Elberfeld and had been patented. This was not known to American scientists at the time they started their search for new antimalarial drugs when the war cut off the supply of quinine from the Dutch East Indies.

The Germans, however, discarded the chemical as no good, while American scientists, once they tested it, recognized its value. The German method of synthesis, moreover, was too complicated to be practical for commercial production of the chemical. This bottle-neck was overcome by Prof. Charles C. Price and Dr. Royston M. Roberts, of the University of Illinois, who developed an original and simple method of synthesis.

Clinical tests of the drug's value were made with the 20 pounds of it which chemists at the University of Illinois worked 24 hours a day, in three shifts, for three weeks to produce. This laboratory-made product was enough for 30,000 doses.

Answers to Chem Quiz on Page 37

acid	boron	helium	palladium
alloy	cadmium	ion	proton
amide	calcium	iridium	silica
barium	cobalt	iron	tin
beryl	copper	lead	TNT
boric acid	DDT	ozone	zinc

Deadly Mist Kills Weeds
But Grass Survives

War on Weeds

➤ CHEMICAL WARFARE against weeds has been launched on a huge scale this year. From coast to coast, whole armies of householders are enthusiastically pumping their spray-guns, dealing death to dandelions that have long made occupied territory of their lawns. Along with the dandelions, plantain, purslane, chickweed, wild garlic and many other disfigurers of green turf are curling up and quitting, under the deadly mist of 2,4-D.

That symbol, 2,4-D, has suddenly become as much a household word as the equally sensational bane to bugs, DDT. Like DDT, it is a synthetic organic chemical—its full name is 2,-4-dichloro-pheno-oxyacetic acid. And like DDT, it is a war recruit, and is only now getting out of uniform.

➤ SPRAYING *with the new chemical 2,4-D will kill plants but let the grass survive. Thus it will help develop lawns but must not be used on flower beds.*

▶ BEFORE SPRAYING *with 2,4-D, poison ivy is a flourishing plant, but afterward . . .*

The great virtue of 2,4-D is what plant scientists call its selective action. It will kill almost any plant except members of the grass family and their near relatives, such as sedges and rushes. That is what makes it so useful on lawns, golfing fairways and putting greens, and everywhere that you want grass and nothing else. It can also be used on weedy pastures, where such bad citizens of the plant world as ragweed and jimson weed have taken over.

Selective action of 2,4-D is not absolute. A few weeds resist it, and a few desirable grasses are harmed by it. This is especially true of the bent grasses, favorites for lawn and park planting in some localities. However, bluegrass, which is what most lawns are made of, can stand repeated sprayings without harm.

Kills Weeds But Not Corn

Another possible use for 2,4-D is killing cornfield weeds and eradicating such pests as wild mustard from fields of small grains; for all our grain crops are members of the grass family, so that the selective action of the weed-killer should work here, too. Preliminary experiments last year looked promising, and more extensive tests will be made this year by federal and state agronomists. Results with sugarcane (another giant grass) have already proven conclusive. Cane planters are enthusiastic.

For mass killing of rank weed growths like poison ivy, Japanese honeysuckle and bindweed or wild morning-glory, 2-4-D looks like a first class weapon. To be sure, it has to be used in stronger concentration to kill these tough vegetable thugs, and more than one spraying will be necessary, but it will get them in the end.

For uses of this kind, where everything in sight is to be killed, 2,4-D will have to meet the competition of another weed killer, ammonium sulfamate. This compound was hailed as the white hope against weeds when it made its first appearance about four years ago, but since it is also a good flameproofing material the whole available supply was needed for war purposes. It was not until after the collapse of the Axis that it became available for civilian purposes. It got a good enough try-out last year, however, to demonstrate its effectiveness.

Replaces Old Weed Killers

Either 2,4-D or ammonium sulfamate, whichever proves cheaper to use, is likely to replace the older mass weed killers, like oil and sodium

➤ DEAD FOLIAGE *shows what the new chemical will do to noxious weeds.*

chlorate. These had to be used in considerable quantity to be effective, and both presented rather bad fire risks. Sodium chlorate, indeed, is used in some kinds of explosives and fireworks. Dead weed leaves with this stuff dried on them can flash into flame like lightning at the touch of an unextinguished match or cigaret.

Tests with 2,4-D last summer showed that it could neutralize ragweed's power to cause hayfever by preventing it from shedding its pollen. By the same token, it would also prevent ragweed from perpetuating its evil kind, for both the common species of ragweeds are annuals, depending on seed for the next year's growth. Some ragweed seed always lies dormant in the soil, ready to come up not one, but three or four years after it is produced. However, successive sprayings of the same patch could exhaust these vital reserves in a few seasons.

Kills Seeds in Soil

Another possible tactic employing 2,4-D is its use in killing weed seeds in fallow fields, before the soil is made ready for a new planting. Tests showed that 2,4-D stirred into the upper layer of the soil would clean out all seeds, including grass seeds. It did the same thing when mixed with manure, which is often a source of weed seed when used for fertilizer.

Yet soil thus treated, as well as the soil under the grass that has been sprayed, does not long hold its 2,4-D content. After a few months it has all disappeared, so that it is safe to plant any kind of seed you wish, even of highly sensitive vegetables and flowers.

What becomes of 2,4-D in the soil? Nobody knows yet; the whole thing is too new. Scientists conjecture that it may be made chemically inert by combination with substances in the soil, or (perhaps more likely) that fungi, which are everywhere and apparently ready to eat anything, may use it up for food. At any rate, it does obligingly get out of the way before next planting time.

Non-Poisonous to Animals

Another nice thing about 2,4-D: it is non-poisonous to human beings and domestic animals. It was tried out on cows and ewes, and had no detectable effect at all on them. Samples of blood drawn from their veins showed its presence, but it did not get into their milk. Also, some hardy scientists swallowed samples of it, and felt no ill effects afterwards.

Just now, 2,4-D is getting practic-

ally all the attention, but it is only one member of a very large chemical family. It has about a hundred fairly close relatives among organic compounds, all of which are known to have effects on plant growth. Probably many of them could be used as weed killers also, and some may be even more effective than 2,4-D.

It should be remembered that 2,4-D is not like other plant poisons in its action. It belongs to the group of chemicals that in small doses cause more rapid growth but otherwise leave the plants normal. In the heavier concentrations used as weed killers it promotes a wild and unhealthy overgrowth of the tissues, causing the leaves to pucker and twist, breaking down all internal communications. The plant acts almost if it had suddenly become tumorous all over, and it dies of sheer inability to make its parts work together properly.

Don't Use on Flowers

If the householder using 2,4-D in his private feud with the weeds in his own yard will remember just one thing, he will not have any trouble. That is the initial fact that 2,4-D will kill practically all plants except grass. It can therefore be used to clean up the lawn, but must never be used on weeds in vegetable or flower gardens.

If you want to use the same sprayer for 2,4-D on your lawn and for insect pests in your garden, you must make sure it is thoroughly cleaned up before putting in the insecticide. All parts of the sprayer must be well washed in hot soapsuds, or better yet, in kerosene.

Don't spray your lawn when there's a breeze stirring. If you do, some of the fine spray may drift onto your flower beds or shrub borders, with unfortunate consequences. If it gets on your neighbor's flowers or shrubs, that's even worse.

Do your spraying only on warm days; temperatures around 80 or 85 degrees Fahrenheit are best. Effects of the poison are best when the weeds' sap is moving most actively, so that it will be carried to the inner tissues and down to the root, getting in its deadly work all over.

Use As Fine Spray

In its pure form, 2,4-D is a white powder, practically insoluble in water. To make a water spray, it is necessary first to dissolve it in another chemical, and then mix this with water. It is in this dissolved form that 2,4-D is now offered on the market, under trade-names like Weedone, Weedex, and the like. When this is mixed with water it still does not dissolve, but forms a milky emulsion which is a very good state for maximum distribution with a sprayer.

Another thing to be remembered is, the finer the spray, the more effective the spraying. This is because tiny drops, like the water droplets in a thick fog or Scotch mist, have much more wetting effect than larger ones. So if you are buying a new spraygun, the best economy is to get the one that produces the finest spray. In that way, you'll get the most dead dandelions per dollar's worth of 2,4-D.

Romania has been Europe's principal producer of natural gas as well as petroleum; Transylvania has large natural gas deposits.

How To Hold Friends And Educate People

Now You Take Magnesium...

by W. C. Mattox

➤ One of the pleasures in life is to tell people what you know. Particularly people who suspect you don't know much. I can't recall any experience that gives more genuine satisfaction than to sit down with some intelligent listener, and amaze him with my knowledge on some specific subject. That satisfaction is doubled if I'm talking to someone of superior intellect—like an executive secretary of a Chamber of Commerce in a big city—like Boston, for instance.

I wouldn't name any names, of course, because the man I'm thinking of is a modest chap, who avoids personal publicity, and he'd be the first to frown on a piece that seemed to reflect credit on him. So just forget any clues you may have as to his identity. Just imagine the fellow I'm talking about is a well-educated man (say Harvard), a student of affairs, and genuinely interested in any subject one wishes to introduce. Incidentally, his sense of humor makes things tough at times for those who expose their chins.

Up Comes Magnesium

"I've been doing some work on magnesium," I began. "You know that's going to be quite a metal for commercial use."

"What can you use it for?" he asked.

"Oh, lots of things. Wheelbarrows, for example."

"Who'd want a magnesium wheelbarrow?"

"Wouldn't you prefer a wheelbarrow that weighs only a fraction—"

"No, I don't want a wheelbarrow. Why should I want a wheelbarrow? I've got one."

"Well, suppose you didn't have a wheelbarrow—"

"But I have," he insisted. "So let's don't waste time on useless speculation. Where does this manganese come from?"

"Not manganese—magnesium."

"Same thing, isn't it?"

"No—manganese is—"

"I thought you were talking about magnesium. Where does it come from?"

"It's extracted from sea water by a process—"

"I don't believe it. Why that's perfectly ridiculous."

"I's a fact, though. In sea water—"

"There used to be yarns flying around about sea water being filled with gold," he said. "Do you believe you can go out and dig gold nuggets out of the ocean?"

"Of course not. But this magnesium is dif—"

"What do they do with the water?"

"What water?"

"The sea water you say they take this magnesium out of."

"I don't know. What do you care? The point is—"

But the man interrupted again.

Pocketfuls of Metal

"The point is you came in here with a wild tale about going down to the beach and filling your pants pockets with some costly metal, and I don't believe it."

"I didn't say a word about my pants pockets, and magnesium isn't a costly metal. At least—"

"What does it cost?"

"I don't know."

"Then how do you know it isn't costly? However, we'll pass that. Where else do they get magnesium?"

"Out of brine wells of Michigan."

"I don't believe that, either. You don't pull up a bucket of metal out of a well. Did you ever dip up metal out of a well?"

"No—but this magnesium—"

"What do you get when you lower a bucket into a well?"

"Water, of course—"

"But you just said you get magnesium. Stick to your tall stories, Bill, and don't ask me to believe palpable falsehoods. I've been out to Michigan, and I know they get water from the wells out there."

"Okay, okay! So they get water out of wells in Michigan. Let's don't fight about it. But you may be interested to know that this new metal, magnesium—"

"What's new about it?"

"It isn't new exactly. But—"

"You said it was new. I'm taking your word for it. What's it good for?"

"To make things. Now you take a wheelbarrow, for instance—"

"I won't take a wheelbarrow. I don't like wheelbarrows. Can't you get wheelbarrows off your mind?"

I'm a patient man, and I knew here was an important subject that the fellow ought to know about. So I started on a different slant.

"Magnesium comes from a mineral, too—a substance called Dolomite. It exists in great quantities—"

"What's Dolomite?" he asked.

"It's an ore from which magnesium is extracted."

What, Not From Sea Water?

"Oh, so it doesn't come from sea water, at all, eh? That's just something you made up."

"I didn't do anything of the sort," I protested. "It does come from sea water. And from brine wells in Michigan. And from an ore called Dolomite. Can't you understand—"

"I can understand a lot of things I hear. But I don't believe everything I hear. I don't believe, for instance, that Boston Harbor is filled with magnesium."

"There's enough magnesium in Boston Harbor to supply the world with magnesium for a hundred years," I said.

"Yeah! But what would Boston do without a harbor? Here we've been trying to build up Boston Harbor for years as a waterway, a shipping port, the best port in the world, the United States port nearest Europe, then you pop in with a subversive plot to pump all the water out of Boston Harbor under the guise of a mining project. I can't subscribe to any such scheme. Besides, how do you know?"

"How do I know what?"

"That there is enough magnesium in Boston Harbor to supply the world for a hundred years. How much water is there in Boston Harbor?"

"I don't know, but—"

"How much magnesium will the world use in a hundred years?"

"I don't know that, either, confound it! I was merely—"

"Better get your facts straight, my lad, before coming in here and trying to ruin our harbor," he advised, condescendingly.

"It wouldn't hurt your damn harbor. The magnesium is a part of the water—"

"Do you mean to tell me that if we took all the water out of Boston Harbor, we'd have any harbor left? That's what makes a harbor—water. Without water we'd have nothing but mud flats. Now I suppose you'll be telling me we can get magnesium out of mud flats."

"Well, I suppose you might at that," I said.

Go Dig Mud Flats!

'Then go dig up some mud flats and let our harbor alone."

"All right, let's forget your harbor. Let's get back to your question."

"What question?"

"Didn't you ask a question awhile back?"

"Did I? I don't recall. I guess I got sidetracked, worrying about Boston Harbor."

"Well to get back to magnesium, then, it's the lightest metal—"

"What's the matter with aluminum?"

"Nothing's the matter with aluminum. It's fine. It's grand stuff. I'm in favor of it. But magnesium is lighter than aluminum."

"So what? Suppose it is lighter. Aluminum is lighter than iron, isn't it?"

"Sure, but—"

"And we still use a lot of iron, don't we? Why do you condemn iron?"

"I don't. I'm in favor of iron. It's a very splendid metal. But I was merely trying to point out that magnesium is the lightest metal for commercial—"

"How much magnesium is lighter than how much iron?"

'A pound of magnesium will—"

"Ha! Don't pull that old chestnut. A pound of magnesium weighs the same as a pound of iron, and you know it."

It was a hot, moist day and I was steadily getting more uncomfortable.

"Listen, my friend. I came in here to tell you about magnesium. I have some information to impart—information that I'm sure will be valuable to you. And what happens?"

Agin Emptying Harbor

"What happens," he answered, "is that you try to sell me a wheelbarrow. I told you frankly that I didn't want a wheelbarrow. Then you talk about emptying Boston Harbor to get some magnesium. I'm agin that project, too. It isn't practical. Then you take some sly digs at iron. I suppose if you went on, you'd try to shut down all the steel mills, and copper mills.

"Frankly, Bill, you wander around a bit in your discourses. I'm tremend-

ously interested in learning all I can about manganese, but—"

"Not manganese! Magnesium!"

The man arched his eyebrows.

"Seems to me we're back where we started. What's the difference between manganese and magnesium?"

"I don't know exactly, but—"

"It strikes me you are taking on quite a contract, my misguided friend. You come in here posing as an expert on magnesium, and now you admit you can't tell it from manganese. If the two metals are that much alike, why discriminate?"

"Okay—let's forget the whole thing. But before we do that, there's one fact you ought to know about magnesium. It possesses a high damping factor."

"Damping factor? What's that?"

"Don't you wish you knew?"

I walked out with a sneer on my lips.

—From Boston Business via Dow Diamond, with appreciation.

Potatoes Dried While Frozen

➤ CALIFORNIA may have sun-dried raisins and prunes; Alaska offers something new—and not under the sun, either, for it is done best in the long, frigid dark of the subarctic winter nights. It is a process for cold-drying potatoes, worked out by Dr. Basil M. Bensin, agronomist at the Alaska Agricultural Experiment Station.

Dr. Bensin's process consists in slicing raw potatoes very thin—from one-sixteenth to one-eighth inch—spreading the slices on a wire-netting frame, and setting them outdoors in the cold air for from 50 to 60 hours. They freeze immediately, but lose water while they are frozen. It is not evaporation, strictly speaking; such loss of water from the frozen state is technically known as sublimation.

In Dr. Bensin's experiments potato slices lost more than 60% of their water content. Their vitamin content remained unchanged, he states.

The potato slices darken on exposure to the air, as all potatoes do. This is a result of a simple enzyme reaction, and does not affect their food value. The original white color can be restored by bleaching with sulfur dioxide, a standard method long in use for bleaching dried fruits and vegetables.

Dr. Bensin believes his process can be applied also to other Alaska-grown vegetables, like carrots, beets and parsnips. The frost-dried products, compact and light-weight, should be useful additions to the food supplies of prospectors, miners, trappers and other men who have to watch the weight of their field rations.

A frozen-dehydration process has been used in the preparation of dried blood plasma and serums and in the crystallization of penicillin. A similar process has also been patented for the preparation of dehydrated foods without heating them, and is expected to be in commercial production within a few months. But these processes require elaborate and expensive refrigeration machinery, and often vacuum pumps as well. All Dr. Bensin needs is a sharp knife, some wire netting and wood—and the Alaska winter.

FOR KEEPING UP WITH SCIENCE

Besides CHEMISTRY, Science Service has three other services for individuals. The weekly magazine, SCIENCE NEWS LETTER, reports the latest developments in all fields of science. THINGS of science are sent each month in a distinctive blue box to a limited number of members—exciting new products, unusual specimens, etc. Teachers in high schools and youth leaders are aided in organizing science clubs—a free service. (Then, of course, there are the news and feature services of Science Service available to newspapers and magazines.)

Clip and Mail This Coupon

To Chemistry, 1719 N. St., N.W., Washington 6, D. C.

☐ Start
☐ Renew

my subscription to CHEMISTRY for

☐ 1 year, $2.50
☐ 2 years, $4.00

(No extra charge for postage anywhere in the world)

To SCIENCE LEWS LETTER, 1719 N St., N.W., Washington 6, D. C.

☐ Start
☐ Renew

my subscription to SCIENCE NEWS LETTER for

☐ 1 year, $5
☐ 2 years, $8

(No extra postage to anywhere in the world)

To THINGS OF SCIENCE, 1719 N St., N.W., Washington 6, D C.

☐ Enter
☐ Renew

my membership in THINGS for

☐ 6 months, $2
☐ 1 year, $4

TO SCIENCE CLUBS OF AMERICA, 1719 N St., N.W. Washington 6, D. C.

☐ Send me information on organizing a science club.
☐ Enroll me as an associate of Science Clubs of America, 25c is enclosed.

Name _____

Street Address _____

City, Zone and State _____